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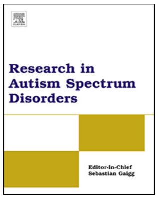

Anxiety moderates the influence of ASD severity on quality of life in adults with ASD

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ABSTRACT

Background: Comorbidity of anxiety and autism spectrum disorder (ASD) in children and adolescents is well-documented. Preliminary evidence suggests rates of comorbidity in adults with ASD may be comparable. Little is known about the manifestation of anxiety symptoms in adults with ASD or the potential for these symptoms to impact quality of life in this population. The current study aimed to examine the role of anxiety symptoms in quality of life among young adults with ASD.
Method: We collected online survey data from a large sample ($N = 224$) of parents of young adults with ASD and a subsample of adults with ASD. We examined prevalence of anxiety symptoms based on reported prior diagnoses and proportion of individuals exceeding clinical cutoffs on anxiety measures. Regression models were used to evaluate anxiety as a moderator of the relationship between ASD symptoms and quality of life.
Results: Based on parent- and self-report data, 48% of adults with ASD exceeded clinical cutoffs for anxiety. Anxiety moderated the relationship between ASD severity and the social relations domain of quality of life such that ASD severity predicted quality of life only among individuals with low levels of anxiety.
Conclusions: Results provide preliminary evidence that anxiety symptoms relate to quality of life in adults with ASD independently of core ASD symptomatology. Future research should further characterize anxiety symptoms among adults with ASD, as well as evaluate the impact of anxiety symptoms on quality of life and overall outcome through the use of prospective longitudinal studies.

1. Anxiety moderates the influence of anxiety on quality of life in adults with ASD

In addition to difficulty with the core symptoms of social communication and restricted and repetitive behaviors, individuals with ASD frequently present with comorbid anxiety symptoms (van Steensel, Bögels, & Perrin, 2011). The comorbidity of anxiety and ASD has been studied extensively in children and adolescents. A substantial body of literature has established comorbidity in the range of 50%. Anxiety disorders frequently found in adolescent samples with ASD include social anxiety disorder (SAD) and generalized anxiety disorder (GAD; White, Oswald, Ollendick, & Scahill, 2009). Anxiety symptoms frequently form the focus of treatment in children and adolescents with ASD.

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Although the research on anxiety in adults is less developed relative to the extant research on children with ASD, preliminary studies suggest that anxiety symptoms are at least as common in adults with ASD as in children and adolescents. Lugnegård, Hallerbäck, and Gillberg, (2011) found that over half (56%) of a sample of 54 young adults with ASD met diagnostic criteria for at least one anxiety disorder. Another study (Maddox & White, 2015) determined that SAD was present in 50% of a non-clinically referred sample of adults. Adults with ASD have also been demonstrated to exhibit significantly more anxiety symptoms than comparison samples with intellectual disability (Gillott & Standen, 2007).

Individuals with ASD have been found to experience lower quality of life than typically-developing individuals. A sample of adults with Asperger's syndrome reported significantly lower social and physical quality of life than a control group, despite comparable living situations, numbers of friends, and levels of education (Jennes-Coussens, Magill-Evans, & Koning, 2006). Another study identified a disconnect between more frequently used objective metrics like education or employment and subjective quality of life; in this study, quality of life and well-being were rated highly despite a lack of overall independence and a strong reliance on caregivers (Billstedt, Gillberg, & Gillberg, 2010). However, the Billstedt sample is likely not representative of the entire spectrum of ASD, given that a large proportion of individuals in that study had severe or profound intellectual disability. Examinations of quality of life in child samples are limited and tend to rely on proxy report, but are consistent in their identification of lower quality of life for youth with ASD than those without (Clark, Magill-Evans, & Koning, 2015; Ikeda, Hinckson, & Krägeloh, 2014). A recent meta-analysis evaluating the impact of ASD diagnoses on quality of life throughout the lifespan reported a large effect size indicating significantly lower quality of life for adults with ASD across all ages as compared to individuals without ASD (van Heijst & Geurts, 2015).

Current research has explored a number of contributors to poor outcome and quality of life in adults with ASD. Perhaps not surprisingly, both ASD symptom severity and cognitive ability in childhood have emerged as the strongest predictors of positive outcome in adulthood (Anderson, Liang, & Lord, 2014; Howlin, Goode, Hutton, & Rutter, 2004). Adaptive functioning has also been associated with improved outcome, as has the presence of disability support (Kanne et al., 2011; Renty & Roeyers, 2006). These findings have been replicated across a number of large-scale, prospective longitudinal studies (Szatmari, Bryson, Boyle, Streiner, & Duku, 2003). Recent explorations specific to quality of life in adults have established that daily living skills, executive functioning, and maternal warmth are associated with greater levels of independence and higher quality of life (Bishop-Fitzpatrick et al., 2016). Examinations of the impact of comorbid mental health problems are underrepresented in the literature, although one recent study identified that the presence of any diagnosed mental health condition negatively predicted quality of life in adults with ASD (McConachie et al., 2018).

Anxiety contributes significantly to poor quality of life in samples without ASD. A meta-analytic study examining quality of life across anxiety disorders found large effect sizes indicative of lower quality of life for individuals with anxiety disorders compared to control groups (Mendlowicz & Stein, 2000; Olatunji, Cisler, & Tolin, 2007). Results specific to Social Anxiety Disorder (SAD) have demonstrated that individuals with that disorder are more likely to suffer from impairment in their main activities and to rate their quality of well-being lower than individuals without SAD (Stein & Kean, 2000). Similar evidence has been found in other studies of social and generalized anxiety and quality of life (Henning, Turk, Mennin, Fresco, & Heimberg, 2007). Given the established impact of anxiety on quality of life in samples without ASD and the prevalence of anxiety among individuals with ASD, there exists a strong possibility that the negative effects of anxiety on quality of life are obscured in the quality of life literature, potentially by explorations of correlated constructs such as ASD severity (South, Carr, Stephenson, Maisel, & Cox, 2017).

No prior research has examined the impact of *both* ASD severity and anxiety in a sample of adults diagnosed with ASD. Given that anxiety disorders and ASD have been found to exert independent, significant negative impact on metrics of quality of life, examination of their non-overlapping influence in adults with ASD is important. Moreover, comorbid presentation of these two disorders may have synergistic effects. Proposed conceptual models have implicated anxiety symptoms as a potential moderator of the established relationship between ASD symptoms and long-term outcome, including quality of life (Wood & Gadow, 2010). Specifically, ASD symptoms may have a diminished impact on quality of life among individuals whose anxiety symptoms are more severe. Better understanding the influence that anxiety has on the achievement of positive outcomes may serve to inform service delivery for adults with ASD.

The purpose of the present study was therefore to determine the extent to which anxiety symptoms relate to quality of life in adults with ASD, independent of the impact of core ASD symptoms. In addition, we attempted to further characterize the extent and nature of anxiety symptoms among adult samples with ASD. Although a cross-sectional analysis will not allow for conclusions regarding directionality, much less causality, preliminary evidence for anxiety as a predictor of outcome could inform longitudinal research in this area. We hypothesized that after controlling for language impairment and medication status, presence of anxiety would significantly and negatively predict social and psychological quality of life. We also predicted that anxiety symptoms would demonstrate a moderating effect such that at high levels of anxiety, ASD severity would have a diminished effect on quality of life.

2. Method

2.1. Participants

Participants for the current study were recruited with the assistance of the Interactive Autism Network (IAN) Research Database at the Kennedy Krieger Institute in Baltimore, MD. IAN is an online volunteer registry of families of individuals with ASD. Families enrolled in the IAN registry have at least one child with a confirmed ASD diagnosis provided by a professional, live in North America, and the probands have a broad range of ages and functioning levels. Total enrollment in the registry exceeds 5000 individuals. Recruitment for the current study was restricted to parents of individuals with autism aged 18–27 years. The age range of 18–27

Table 1
Demographics of Adults with ASD, as Reported by Parents.

Variable	*n*	%
Gender		
Male	160	82.05
Female	35	17.95
Ethnicity		
White	181	92.82
Black	5	2.56
Latino	4	2.05
Asian	4	2.05
Other	5	2.56
Age of diagnosis		
Before 3	77	31.05
Age 3-5	86	34.68
Age 6-7	39	15.73
Later than 7	46	18.55
Language use		
Typical use	56	22.76
Pragmatic/social difficulties	115	46.75
Difficulty expressing needs	72	29.27
Medication for anxiety		
Yes	41	16.80
No	203	83.20
Level of education		
Less than high school	65	26.42
High school diploma/GED	101	41.06
Some college	51	20.73
Associate's degree	11	4.47
Bachelor's degree	14	5.69
Living situation		
With parents or other family	197	80.08
Roommates	13	5.28
Paid caregiver	19	7.72
Alone	17	6.91
Variable	N	M(SD)
Child age	195	21.77 (3.10)
Parent age	191	54.26 (6.31)

closely mirrors the "emerging adulthood" age range (Arnett, 2000). Although evidence suggests anxiety disorders typically onset earlier, during adolescence (Beesdo et al., 2007), unremitting anxiety symptoms may begin to exercise an greater impact in functioning during emerging adulthood given the range of activities associated with this period (e.g., living independently, beginning postsecondary education or employment). Parents were selected as the primary respondents due to the low response rate typically seen in online self-report research with young adults with ASD (Gotham et al., 2015). Prior research has relied upon parent-report for collection of quality of life data, though with mixed results (Hong, Bishop-Fitzpatrick, Smith, Greenberg, & Mailick, 2016; Kamio, Inada, & Koyama, 2013).

Of 389 participants who responded to the study interest form, 224 parents completed the survey. Upon completion of the survey, parents were invited to provide contact information for their adult child (hereafter referred to simply as "adult") with ASD, who were recruited for the secondary self-report portion of the study. Adults were between 18 and 27 years of age (M = 21.86, SD = 2.97), primarily male (81%), and Caucasian (93%). Parent respondents reported age ($M = 53.76$, $SD = 6.70$) and level of education (80% completed college or graduate degree). Secondary respondents included 41 adult self-report participants. The 41 self-report participants were compared to the larger sample of parent-report participants on basic demographic characteristics. The self-report participants did not differ on the basis of age or living situation, but were significantly more likely to be characterized by "language use is completely typical" than either of the other two language descriptors, X = 12.06, $p = 0.002$. See Table 1 for complete demographic information.

2.2. Measures

2.2.1. Screen for anxiety and related emotional disorders (SCARED; Birmaher et al., 1997)

The SCARED parent-report version was used to screen for anxiety disorders. The SCARED includes subscales for the following types of anxiety: Panic Disorder/Somatic Symptoms, Generalized Anxiety Disorder, Separation Anxiety, SAD, and School Avoidance. The SCARED consists of 41 items rated on a three-point scale (i.e, 0 = not true, 1 = somewhat true; 2 = very true). A total score of 25 or higher suggests the potential presence of an anxiety disorder. Adequate internal consistency, test-retest reliability, and discriminant validity of the SCARED have been previously established (Birmaher et al., 1997). While the sensitivity and specificity of the SCARED in ASD samples has not been established, there are currently no ASD-specific anxiety measures validated for widespread use in adults (Kerns et al., 2015; Mazefsky, Kao, & Oswald, 2011). Of available measures, the SCARED has been frequently employed for ASD samples, with available evidence providing moderate support for its validity (Blakeley-Smith, Reaven, Ridge, & Hepburn, 2012; van Steensel, Deutschman, & Bögels, 2013). Further, no measures exist to measure adults' anxiety symptoms as reported by parents, requiring upward extension of a measure designed for children and adolescents. Prior literature has relied heavily on parent-reported anxiety in adolescents (Gillott & Standen, 2007; van Steensel et al., 2011). The SCARED was normed on a sample of individuals between the ages of 9 and 19 (Birmaher et al., 1999). Approximately 25% of the current sample reported their age as 18 or 19, indicating the measure was appropriately normed for these individuals. Items used in the current study were also re-worded to upward extend the measure for parent report of adult samples (e.g., "My son/daughter gets headaches when s/he is at school" to "My son/daughter gets headaches when s/he is at school or work"). For those adults completing surveys, a self-report version of the SCARED was included, with items similarly adapted. Internal consistency for the parent report total score of this measure was α = .93, and internal consistency for the total score of this measure in the self-report sample was α = .96.

2.2.2. *The social responsiveness scale, second edition (SRS-2S^{-2}; Frazier et al., 2013)*

The SRS-2 relative/other report was completed by parents of adults with ASD. The SRS-2 and its predecessor, the SRS, are among the most well-validated and frequently used measures of ASD severity (Constantino et al., 2003; Frazier et al., 2013). The SRS-2 consists of 65 items with subscales in the domains of social awareness, social cognition, social communication, social motivation, and autistic mannerisms. Internal consistency for this measure was α = .95.

2.2.3. *World health organization quality of life-brief (WHOQoL group, 1998)*

The WHOQOL-BREF is broadly supported as a reliable and valid measure of quality of life as influenced by physical or mental disability. The measure assesses the domains of physical health, psychological well-being, social relationships, and environment (e.g., home environment, financial resources, participation in recreation & leisure activities, etc.). Consistent with prior literature, the social relationships and psychological domains of both parent- and self-report versions of this measure were used in the current study (Kamio et al., 2013). In samples of adolescents, parent- and self-report of quality of life have demonstrated strong associations (Shipman, Sheldrick, & Perrin, 2011). Additionally, recent work has identified evidence for the validity of this measure in samples of individuals with ASD (McConachie et al., 2018), although the association between self- and parent-reported quality of life was found to be weak in another recent study (Hong et al., 2016). In order to encourage parents to reflect upon their adult's experience and maximize the association between the two reporters, instructions were provided as follows: "The following questions ask how you feel about your son/daughter's quality of life, health, or other areas of his/her life. Please choose the answer that appears most appropriate. If you are unsure about which response to give to a question, the first response you think of is often the best one. Please keep in mind your son/daughter's standards, hopes, pleasures and concerns. We ask that you think about your son/daughter's life in the last four weeks." Internal consistency for the parent-report version of this measure was α = .91, while internal consistency for the self-report version was α = .94. Internal consistencies for the 3-item social relations and 6-item psychological subscales of the parent-report version (used for analyses) were α = .80 and α = .76, respectively.

2.2.4. *ASD diagnoses and demographic information*

In addition to the standardized measures described above, we included a set of demographic questions in order to more accurately characterize our sample. These items provided additional information regarding initial diagnosis, education, independent living skills, social relationships, and medication use. To inquire about medication use, parents were given a list of potential means of addressing anxiety (e.g., cognitive-behavioral therapy, medication, exercise, etc.), and asked to check all items that applied; a blank box was also offered so that parents could specify specific types of medication. Items regarding initial diagnosis pertained to what each adult's first ASD diagnosis was, who had provided it, and whether the diagnosis had changed over time (e.g., from Asperger syndrome to ASD). Additionally, a 3-point item was used to determine the level of language use to establish each individual's verbal comprehension and expression abilities (1 = language use is completely typical, 2 = difficulties with pragmatic language, 3 = difficulty expressing needs using spoken language).

2.3. *Procedure*

Parents of individuals with ASD who had previously registered with IAN and who had adults with birthdates placing them in the 18–27 target age range were emailed an invitation to complete a contact form for the current study. Individuals expressing interest via completion of the contact form were emailed a secure link to complete the study online. The total set of measures completed by parents and relevant to the current study consisted of demographic items, SRS-2, SCARED, and WHOQOL-BREF. Parents who completed the survey were offered an opportunity to enter a gift card raffle. Self-report responses were recruited via parents who had completed the initial (primary) portion of the study. The total set of measures filled out by self-report respondents consisted of the SCARED and the WHOQOL-BREF. Following completion of the self-report survey, self-report participants were invited to enter a separate gift card raffle.

2.4. *Data analytic plan*

All data were analyzed using IBM SPSS Statistics Version 20.0. Prior to conducting analyses evaluating moderating effects of anxiety, data were screened for normality of distributions and multicollinearity. Univariate and multivariate outliers were examined;

values greater than three standard deviations from the mean were Winsorized. To test the primary hypotheses, that anxiety would independently predict quality of life as well as moderate the relationship between ASD severity and quality of life, we evaluated two separate regression models using parent-reported data. We evaluated models using parent-report data in order to maximize our sample size and retain statistical power for moderation analyses. Specifically, anxiety (SCARED total score) was entered as a moderator of the relationship between ASD severity and the social and psychological domains of the WHOQOL-BREF. In both models, a three-point categorical variable for language use (i.e., language use is completely normal, difficulties with pragmatic or social language, difficulties expressing needs) and a dichotomous variable for anxiety medication status were entered as covariates. Language use was entered as a covariate in part due to reliance on parents' reports. Specifically, in order for parents to accurately characterize their adult's symptoms, the adult would need to communicate such information to the parent. Medication for anxiety was included due to the prevalence of psychotropic medication for anxiety in individuals with ASD. One study indicated that as many as 80% of individuals with ASD and a comorbid diagnosis may be prescribed psychotropic medications (Coury et al., 2012). These medications by design alter the types of symptoms (i.e., anxiety) targeted in the current study.

The presentation of anxiety in the adult ASD sample was examined through parent-report and self-report versions of the SCARED. Presence of clinically significant anxiety symptoms was determined by number of individuals exceeding cutoff scores on the SCARED total score, as well as cutoffs for subscales including panic, GAD, separation anxiety, SAD, and school avoidance. Additional items in the survey inquired about presence of comorbid anxiety diagnoses delivered by a professional.

3. Results

Descriptive statistics were computed for all demographic variables. In terms of level of functioning, the majority of respondents indicated that their adult son or daughter used spoken language, though with frequent endorsement of items related to difficulty with social or pragmatic use of language. All individuals had received prior professional-diagnosed ASD diagnoses, most often made by clinical psychologists or teams of health professionals (48%); physicians (28%) and psychiatrists (16%). First diagnoses reported included Pervasive Developmental Disorder-Not Otherwise Specified ($n = 94$, 38%; PDD-NOS), Autistic Disorder ($n = 68$, 27%), and Asperger's syndrome ($n = 66$, 27%) per DSM-IV-TR (American Psychiatric Association, 2000). Based on parent-report, the adults with ASD had approximately average cognitive ability and impairment from ASD symptoms, and moderate levels of independence (e.g., at least a high school education, a substantial portion with some type of employment). See Table 1 for full demographic results.

Nearly half (46%) of all respondents reported that their adult had been formally diagnosed with an anxiety disorder at some point during their lifetime. Parents reported moderate levels of anxiety for their adults as measured by SCARED total scores ($M = 19.61$, $SD = 13.04$). The proportion of individuals exceeding clinical cutoffs on any subscale of the parent-report SCARED ranged from 19% to 32%. The self-report sample also completed the SCARED, with proportions exceeding cutoffs ranging from 32% to 54%. Similar patterns were evident across parent- and self-report samples in terms of proportion of individuals exceeding clinical cutoffs in each subscale (Table 3). To determine agreement between parents and adults on subscales exceeding clinical cutoffs (for the subsample with both parent- and self-report), dichotomous variables were created (0 = below cutoff, 1 = above cutoff). We then calculated Cohen's Kappa to determine whether agreement was significantly greater than chance. Results indicated fair to moderate and statistically significant agreement on all domains, including panic disorder ($\kappa = .51$, $p = .001$), GAD ($\kappa = .37$, $p = .01$), separation anxiety ($\kappa = .38$, $p = .001$), social anxiety ($\kappa = .32$, $p = .046$), school/work avoidance ($\kappa = .48$, $p = .003$), and total scores, ($\kappa = .32$, $p = .049$). In terms of continuous scores, strong associations were present between parent- and self-reported data, with all subscales as well as total scores demonstrating significant medium to large correlations (rs .42–.59, all ps $< .05$; see Table 5). Relative to their parent-reports, the adults self-reported significantly greater levels of generalized and separation anxiety, as well as overall anxiety symptoms as indexed by SCARED total scores based on a series of paired-samples t tests (Table 2). Differences in social and psychological quality of life were nonsignificant between the parents and the adults. Again, parent- and self-reported reports were significantly associated for both social ($r = .52$) and psychological ($r = 0.38$) subscales.

All regression analyses utilized parent-reported data. In the first step of the hierarchical multiple regression, language and medication use were entered as covariates; ASD severity was then added to the model. The initial model (i.e., with covariates and ASD severity as predictors) explained approximately 4% of the variance in quality of life in the social domain, $F(3, 220) = 2.98$, $p =$

Table 2
Parent- versus Self-reported Symptoms.

	n	Mean (SD)		n	Mean (SD)	t
Parent Report			Self-Report			
SRS Total T Score	230	70.09 (9.80)	–	–	–	–
SCARED Panic	241	3.46 (3.97)	SCARED Panic	41	5.56 (6.50)	−1.62
SCARED GAD	241	5.51 (.68)	SCARED GAD	41	8.34 (4.88)	−2.84**
SCARED Separation	241	2.76 (2.88)	SCARED Separation	41	4.29 (4.24)	−2.42*
SCARED Social	241	6.33 (4.10)	SCARED Social	41	7.59 (4.47)	−1.07
SCARED School Avoid	241	1.56 (1.90)	SCARED School Avoid	41	2.00 (2.28)	−.30
SCARED Total	241	19.62 (13.04)	SCARED Total	41	27.78 (18.19)	−2.17*
QoL Psychological	236	65.02 (16.08)	QoL Psychological	37	63.63 (17.91)	−.14
QoL Social Relations	236	50.67 (20.22)	QoL Social Relations	37	49.55 (25.45)	−1.55

Note. * $p < .05$ (2-tailed), ** $p < 0.01$ (2-tailed).

Table 3
Proportion of Individuals Exceeding Cutoffs on SCARED.

	Parent Report (n = 241) n (%) above cutoff	Self-Report (n = 41) n (%) above cutoff
SCARED Panic	46 (19.50)	13 (31.70)
SCARED GAD	58 (24.58)	19 (46.30)
SCARED Separation	47 (19.92)	16 (39.00)
SCARED Social	86 (36.44)	22 (53.70)
SCARED School	61 (25.85)	15 (36.60)
SCARED Total	76 (32.30)	20 (48.80)

0.03. In the next step, the main effect of anxiety was found to add significantly to the variance explained by the initial model, $\Delta R^2 = .04$, $F(4219) = 4.59$, $p = 0.003$. The full model, with the interaction of ASD severity and anxiety, predicted approximately 9% of the variance in the social relations domain of the WHOQOL-BREF, $F(5218) = 4.52$, $p < 0.001$. The addition of the interaction term (i.e., multiplication of standardized SRS^{-2} and SCARED total scores) explained significantly more variance than the previous model, $\Delta R^2 = 0.02$, $F(1218) = 3.98$, $p = 0.047$. Thus, a significant moderating effect of anxiety was present for the relationship between ASD severity and quality of life in the social domain. Simple slopes were calculated for the association between ASD severity and social quality of life for low (one standard deviation below the mean), moderate (mean) and high (one standard deviation above the mean) levels of anxiety. Simple slope tests revealed that the ASD severity significantly predicted quality of life at low levels of anxiety ($\beta = -.24$, $p = 0.02$), but not at moderate ($\beta = -.11$, $p = 0.18$) or high ($\beta = .02$, $p = 0.86$) levels of anxiety (Fig. 1).

The same regression model was run with psychological quality of life as a dependent variable. Covariates were again entered in the first step of the regression. The initial model, with covariates and ASD severity entered as predictors, explained approximately 7% of the variance in the psychological domain of quality of life, $F(3220) = 6.88$, $p < .001$. Adding the main effect of anxiety significantly added to the explained variance, $\Delta R^2 = .14$, $F(4219) = 16.27$, $p < 0.001$. However, when the interaction term was added, the model did not explain significantly more variance, $\Delta R^2 = .009$, $F(1218) = 2.60$, $p = 0.11$, suggesting that a moderating effect was not present for quality of life in the psychological domain. Full regression results are presented in Table 4.

4. Discussion

The goal of this study was to better understand the role of anxiety as it relates to quality of life among young adults with ASD. Our primary hypothesis, that total anxiety symptoms would moderate the relationship between ASD severity and social and psychological domains of quality of life, was partially supported. The addition of the interaction term of ASD severity and anxiety significantly increased the proportion of variance explained in quality of life in the social domain. The significant moderating effect suggests that ASD severity is less predictive of social quality of life for individuals with high levels of anxiety than low anxiety. Based on this result, we may infer that anxiety symptoms offer the potential to contribute significantly to outcome and subjective quality of life for individuals with ASD. We did not identify a similar moderating relationship when the psychological domain of quality of life was used as a dependent variable. However, for both the social and psychological domains, anxiety contributed significantly to the variance explained by the models, above and beyond the predictive value of language use, medication, and ASD severity. Such results are consistent with the recent finding that presence of diagnosed mental health conditions (including anxiety) negatively predicts quality of life in adults with ASD (Mason et al., 2018)

The broad nature of the constructs assessed as dependent variables may have further implications for the results of the current study. The psychological domain of the quality of life measure used in the current study incorporates a substantial number of topics,

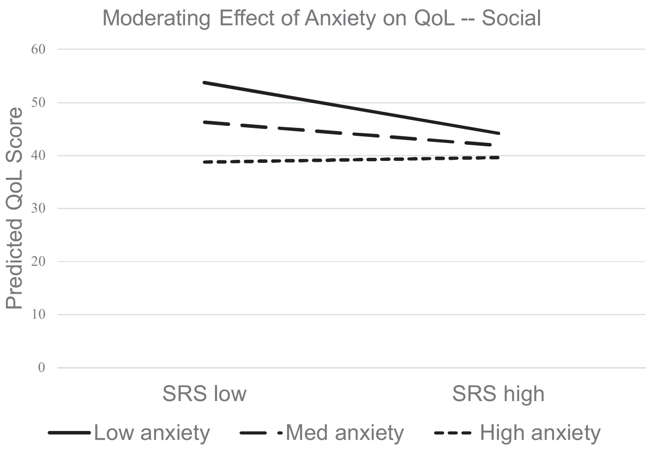

Fig. 1. Moderation Effects for Social Relations domain of WHOQOL-BREF.

Table 4
Regression Results.

	Dependent Variable: Social Relations Domain				Dependent Variable: Psychological Domain			
	β	*F*	Adj. R^2	ΔR^2	β	*F*	Adj. R^2	ΔR^2
Model 1		1.31	.003	–		1.62	.005	–
Language use	.02				−.02			
Medication	.11				−.12			
Model 2		2.98*	.03	.03*		6.88**	.07	.07**
Language use	.13				.16*			
Medication	.11				−.12			
ASD Severity	−.20*				−.33**			
Model 3		4.59**	.06	.04**		16.27**	.22	.14**
Language use	.07				.05			
Medication	.17*				−.02			
ASD Severity	−.13				−.18*			
Anxiety	−.21**				−.41**			
Model 4		4.52**	.07	.02*		13.63**	.22	.01
Language use	.09				.06			
Medication	.18				−.01			
ASD Severity	−.11				−.17*			
Anxiety	−.25**				−.44**			
Anxiety X ASD severity	.14*				.10			

Table 5
Correlations of Parent- and Adult-report Measures.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Panic (self)	–															
2. GAD (self)	.66**	–														
3. Separation (Self)	.73**	.50**	–													
4. Social (self)	.40**	.63**	.36*	–												
5. School (self)	.72**	.49**	.61**	.52**	–											
6. Total (self)	.89**	.84**	.79**	.71**	.78**	–										
7. QoL Psych (self)	−.54**	−.60**	−.43**	−.38*	−.45**	−.61**	–									
8. QoL Social (self)	−.27	−.15	−.08	.01	−.32	−.19	.44**	–								
9. Panic (parent)	.52**	.15	.46**	.16	.59**	.45**	−.19	−.23	–							
10. GAD (parent)	.38*	.42**	.20	.16	.29	.37*	−.16	−.30	.43**	–						
11. Separation (parent)	.27	−.11	.59**	.08	.46**	.29	.03	−.08	.67**	.27	–					
12. Social (parent)	.15	.17	.15	.55**	.31	.31	.05	.27	.41**	.19	.37*	–				
13. School (parent)	.29	.03	.45**	.19	.47**	.32*	−.10	−.11	.76**	.48**	.75**	.45**	–			
14. Total Anx (parent)	.44**	.20	.48**	.31	.56**	.47**	−.10	−.12	.87**	.64**	.78**	.65**	.87**	–		
15. QoL Psych (parent)	−.34*	−.23	−.36*	−.08	−.28	−.33*	.38*	.55**	−.34*	−.42**	−.19	−.01	−.34*	−.34*	–	
16. QoL Social (parent)	−.18	−.14	−.23	.05	−.11	−.16	.10	.52**	−.22	−.31*	−.16	.07	−.18	−.21	.68**	–

including body image, negative and positive feelings, self-esteem, religion, and memory and concentration. In contrast, the social relation domain focuses only on personal relationships, social support, and sexual activity (WHOQoL Group, 1998). While some of the constructs assessed in the psychological domain are likely impacted by anxiety symptoms in adults with ASD (e.g., positive and negative feelings, thinking, learning, memory, and concentration), other components of this domain of quality of life may be unrelated to the manifestation of anxiety in ASD. Still others may serve as protective factors (e.g., religion and spirituality). Symptoms assessed by the social relations subscale more likely map directly onto core deficits of ASD and are consistent with literature reporting high levels of loneliness and low levels of social support in adults with ASD (Howlin et al., 2004; Mazurek, 2014). In considering these interpretations, we wish to emphasize our reliance on parent-reported quality of life. Although past literature has suggested that the association between parent- and adult-reported quality of life may be weak (e.g., Hong et al., 2016), our results identified relatively stronger associations. The subjective nature of the construct renders proxy report an inherently difficult proposition. While future work should utilize self-report where possible, specific and explicit instructions regarding reflection on the rated individual may improve the validity of proxy report ratings.

The current results also suggest that future research should explore the relative contributions of different types of anxiety. Specifically, the SAD subscale had the greatest proportion of individuals exceeding the clinical cutoff for both parent- and self-report samples (36% and 54%, respectively). Such a result is consistent with literature establishing SAD among the most commonly diagnosed anxiety disorders in cognitively unimpaired youth with ASD (White et al., 2009). Although the contribution of anxiety to social quality of life was relatively small and our analyses were cross-sectional in nature, future longitudinal work may explore a previously proposed model in which unsuccessful social encounters contribute to the development of anxiety and potentially poor quality of life (Wood & Gadow, 2010). In this manner, some individuals, including those with greater levels of social motivation, genetic risk, or comorbid symptoms apart from anxiety, may be more likely to develop anxiety symptoms than others, and experience poorer outcome as a result.

Ancillary to our primary aim of evaluating the impact of anxiety symptoms on quality of life, our results suggest that clinically elevated symptoms of SAD and GAD were highly prevalent as evaluated by both parent- and self-report. The current parent-report sample provides data on a substantially larger sample of adults than previous studies of anxiety in adults with ASD (Lugnegård et al., 2011; Maddox & White, 2015). Both parent- and self-report data in the current study indicated rates of clinically elevated anxiety symptoms that are comparable to established prevalence of anxiety among children and adolescents (van Steensel et al., 2011). Comparisons between self- and parent-report data indicated that adults with ASD reported greater levels of anxiety than did their parents in the domains of generalized, separation, and total anxiety. This result stands in contrast to prior work examining parent-child informant discrepancies suggesting youth under-reporting of anxiety in ASD (White, Schry, & Maddox, 2012). The increased anxiety reported by adults may be attributable to the inherent difficulty associated with other-report of internalizing symptoms. However, this result may also be a valid reflection of symptoms, and a relative inability of parents to report on the symptoms of their adult offspring, some of whom live independently and have limited contact with their parents. Future work assessing rates of anxiety in large samples of adults with ASD via parent- and self-report will be necessary prior to making broad conclusions regarding the potential for these symptoms to impact quality of life or overall outcomes.

The results described above should be considered within the context of the sample for the current study. The proportion of the variance explained by each of the models was relatively small, potentially due to an inability to comprehensively assess language use and/or cognitive ability. Additionally, demographic results suggested that participants were relatively homogenous with regard to age, ethnicity, and education. Nonetheless, in terms of reported educational attainment, employment status, and language use, the sample was broadly representative of previous studies of outcomes in adults with ASD (e.g., Taylor & Seltzer, 2011). The similarity of this sample to those in other studies examining similar constructs provides initial support for generalizability of results; that is, symptoms of anxiety may well play a role in determining outcome for individuals at a variety of levels of functioning.

The results of the current study should be interpreted in light of additional limitations. Foremost among these was the lack of available ASD-specific, parent-report measures for the constructs of interest. Specifically, a valid and reliable measure to assess anxiety of an adult via parent- or other-report does not exist, requiring the upward extension of a measure designed for children and adolescents. Although the majority of the items in the SCARED likely map well onto anxiety symptoms as they manifest in young adulthood, specific subscales (e.g., separation anxiety, school avoidance) are likely to have limited applicability to adults or to function differently in ASD samples. The use of IAN for online recruitment also limited our ability to fully characterize our sample in terms of verification of diagnosis via best-practice measures such as the ADOS^{-2} (Lord et al., 2012). However, a study conducting a medical record review of IAN families to verify the accuracy of parent-reported diagnoses indicated that over 98% of families provided records supporting diagnoses made by a professional (Daniels et al., 2012).

Despite these noted limitations, our results provide several avenues for further study of these constructs in this population. Perhaps most critical is a longitudinal examination of the impact of anxiety on outcomes in adults with ASD. Such a study might well seek to rely more heavily on self-report data, for which a broader array of valid anxiety measures exists. A potential longitudinal study would also benefit from comprehensive assessment of the duration of various anxiety diagnoses. Another of the study's aims, to further establish the prevalence of anxiety symptoms in adults with ASD, merits further exploration. Although the current study expands upon the limited empirical evidence for widespread prevalence of anxiety among adults by finding the same trend in a larger sample, use of a single parent/self-report measure to determine presence of clinically significant symptoms of anxiety limits the validity of the results. Future research should aim to identify true rates of anxiety disorders among adults with ASD using self- and other-report measures as well as clinical interviews administered by trained clinicians.

Our results offer several implications for the study of comorbidity of anxiety and ASD and its potential impacts on quality of life. The moderating effect of anxiety identified in the current study provides preliminary evidence for a new factor contributing to the historically poor outcomes typically seen in adults with ASD. While core ASD symptoms, cognitive ability, and adaptive functioning remain among the strongest predictors for high quality of life, anxiety likely plays a meaningful role, particularly among individuals with greater cognitive ability. Given the shared etiology of ASD and anxiety and the potential for ASD symptoms to confer increased risk for development of anxiety disorders, the relationship between these two symptom domains in adults must be further clarified. If, as hypothesized, anxiety serves as a barrier to achieving high quality of life and positive outcome in adults with ASD, the development and evaluation of ASD-specific treatments targeting anxiety symptoms in adults offers potential for facilitating increased independence, decreasing public health costs, and improving functional outcomes of adults with ASD.

Conflict of interest statement

The authors have no conflict of interest to disclose.

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