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Relationships between Autism Spectrum Disorder and Intolerance of Uncertainty

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Abstract

Intolerance of uncertainty (IU) is a dispositional risk factor involving maladaptive responding under conditions of uncertainty. Recent data indicate that IU is likely elevated in youth with autism spectrum disorder (ASD) and is positively correlated with anxiety. This study examined whether IU may be associated with ASD independent of anxiety. Relationships between anxiety, ASD, and IU were examined in 57 children with ASD without co-occurring intellectual disability and 32 control participants, ages 7 to 16 years. Hierarchal linear regressions were run to examine whether ASD variables, including emotion dysregulation, were predictive of IU when controlling for anxiety. Severity of social communication deficits, repetitive behaviors, and emotion dysregulation were each related to IU when controlling for the effects of anxiety. When these ASD variables were entered together, emotion dysregulation was the only significant predictor of IU. These findings suggest that IU is directly related to features of ASD possibly due to shared genetic, neurological, or psychological underpinnings.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

Compliance with Ethical Standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Lay Summary—Youth with ASD without co-occurring intellectual disability experience high levels of intolerance of uncertainty (IU), which is related to anxiety. This study found that IU may also have a relationship with certain aspects of ASD, particularly emotion dysregulation.

Keywords

autism; anxiety; worry; intolerance of uncertainty; emotion dysregulation

Introduction

Intolerance of Uncertainty (IU) is a dispositional trait involving maladaptive responding under conditions of uncertainty (Buhr & Dugas, 2009; Carleton 2012, 2016). IU differs from anxiety, which is a tripartite construct that consists of cognitive, physiological and behavioral components (Knappe et al., 2013). In typically developing (TD) child and adult populations, IU has been tightly linked to various anxiety disorders including generalized anxiety disorder, social anxiety disorder, and obsessive compulsive disorder (e.g., Carleton et al., 2012; Lee et al., 2010). Existing data indicate that youth with ASD may have higher levels of IU compared to TD populations (e.g., Boulter et al., 2014; Chamberlain et al., 2013; Neil et al., 2016), and that IU may be related to the presence of co-occurring anxiety. Some researchers have hypothesized that IU may be inherently associated with certain features of ASD and when present at high levels can increase risk for anxiety (Boulter et al., 2014). Further understanding of the relationships between IU, anxiety, and ASD is needed to develop improved treatments for anxiety or prevent anxiety in youth with ASD (Keefer et al., 2016).

Recent data indicate that repetitive behaviors and sensory sensitivities are linked to IU. For example, the “higher order” restricted and repetitive behaviors such as insistence on sameness and inflexible adherence to routines in ASD may function as strategies to avoid uncertainty by preventing unexpected events and controlling one’s environment (e.g., Lidstone et al., 2014; Rodgers et al., 2012). IU is also directly related to sensory sensitivities when controlling for anxiety (Neil et al., 2016), and together with anxiety may mediate the relationship between sensory processing abnormalities and repetitive behaviors in children with ASD (Wigham et al., 2015).

IU may also be related to other aspects of ASD. Emotional dysregulation (ED), which is defined as deficits in the ability to modulate experienced and expressed emotional states in the service of engaging in adaptive or goal directed behaviors (Thompson, 1994), is ubiquitous to ASD (White 2014). Youth with ASD frequently display increased negative and decreased positive emotional responses, poor recognition and differentiation of emotions, and decreased use of adaptive coping strategies (Mazefsky et al., 2013). White et al. (2014) have suggested that ED is a risk factor for anxiety in the ASD population and have proposed a number of potential mechanisms that may mediate the relationship between ED and anxiety including socio-cognitive deficits, attention biases, and atypical neural connectivity. This same model can be applied to IU, i.e., those with more severe ED may be at increased risk for IU due to more pronounced difficulty in regulating responses to uncertainty.

In summary, preliminary evidence suggests that IU may be uniquely related to both anxiety and certain features of ASD (e.g., Neil et al., 2016). The current study advances our understanding of these relationships by investigating the relationship between IU and specific ASD features. There are several aims of this study. First, we sought to replicate previous findings (Boulter et al., 2014; Chamberlain et al., 2013; Neil et al., 2016) indicating that children with ASD experience higher levels of IU and anxiety compared to TD youth (Aim 1). Next, we aimed to replicate the positive relationship between IU and anxiety in youth with ASD and also examine new correlations between IU and other ASD features, including social communication deficits, repetitive behaviors, and ED (Aim 2). Finally, we examined whether ASD variables, including ED, would be related to IU when controlling for anxiety (Aim 3).

Methods

The sample consisted of 57 children with ASD and 32 control participants, ages 7 to 16 years. The sample is a subset of children participating in a larger study investigating motor skill learning in ASD. Methods for the larger study are described elsewhere (e.g., Ament et al., 2015; Marko et al., 2015; Mostofsky et al., 2009). Participants were recruited from the community (i.e., schools, doctors' offices, community events, community centers, the Interactive Autism Network), and referrals from a specialized autism clinic as well as university physicians.

All participants in the ASD group met research diagnostic criteria on the Autism Diagnostic Observation Schedule (ADOS or ADOS-2; Lord et al., 2002, Lord et al., 2012) and Autism Diagnostic Interview-Revised (ADI-R; Lord et al., 1994). Intellectual functioning was evaluated using the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2004). Children were eligible to participate if they had a Full Scale IQ greater than 80. However, if this criterion was not met, children were eligible if their Verbal Comprehension Index (VCI) or Perceptual Reasoning Index (PRI) was greater than 80 and the lower of the two was at least 65. Children were excluded from the study if there was (a) presence or history of a definitive neurologic disorder; (b) presence of a severe chronic medical disorder; (c) presence of a major visual impairment; (d) history of alcohol/substance abuse or dependency; or (e) conditions that contraindicated an MRI (cardiac pacemaker, surgical clips in the brain or blood vessels, dental braces, etc.). Additionally, in the ASD group, children were excluded if they had a history of known etiology for autism (e.g., fragile X syndrome, Tuberous Sclerosis, phenylketonuria, congenital rubella), history of documented prenatal/perinatal insult, or if they showed evidence for meeting criteria for additional psychiatric diagnoses including major depression, bipolar disorder, conduct disorder, or adjustment disorder, based on parent and child responses from the Diagnostic Interview for Children and Adolescents (DICA: Reich, 2000). Children with comorbid anxiety disorders and obsessive-compulsive disorder (OCD) were included. During the course of the study, the inclusion criteria were expanded to include youth with depressive disorders in order to maximize recruitment. One participant had a history of major depression and another with dysthymia. Children were included in the TD control group if they: (1) did not meet published cutoff criteria for ASD on the Social Responsiveness Scale, Second Edition (SRS-2: Constantino & Gruber, 2012); (2) did not have a history of a

developmental disorder or a psychiatric disorder based on maternal and child responses from the DICA and (3) were free of immediate family members (sibling, parent) with autism or other pervasive developmental disorder.

Sample characteristics are presented in Table 1. Participants in the ASD and TD groups did not differ in mean age or gender distribution. IQ scores (WISC-IV VCI) were higher in the TD group compared to the ASD group. Participants in the ASD group scored higher on measures of social communication severity (SRS-2 Social Communication Index), repetitive behaviors (Repetitive Behavior Scale-Revised Total Score; Lam & Aman, 2007), and ED (Behavior Rating Inventory of Executive Function Emotion Control subscale; Gioia, Isquith, Guy, & Kenworthy, 2000). Participants in the ASD group had similar rates of mental health diagnoses on the DICA as compared to other ASD community samples (e.g., Simonoff et al., 2008).

All participants completed either the parent or child measure of IU; 70 participants had both measures completed (79%). Twenty-four participants (27%) had missing data for some of the measures. Participants with and without missing data did not significantly differ in regard to IQ or demographic characteristics. Listwise deletion was used.

Measures

Sample Characterization—Children in the study were assessed using well-established psychiatric instruments. An ASD diagnosis was supported by the ADI-R and the ADOS. The ADI-R (Lord et al., 1994) is a standard structured diagnostic interview and the ADOS (or ADOS-2; Lord et al., 2002, Lord et al., 2012) is a semi-structured assessment of communication, social interaction, and play. The WISC-IV, an assessment of cognitive ability in children between the ages of 6 and 16 years, was used to assess participant IQ (Wechsler, 2004). The DICA (Reich, 2000), a structured interview screening measure to assess the psychiatric status of children using DSM-IV criteria, was used to screen for the presence of psychiatric disorders. The DICA yields good reliability and validity for both children and adolescents (De la Osa et al., 1997).

Dependent Variable—The dependent variable was IU. This was measured using the Intolerance of Uncertainty Scale: Child and Parent Versions (IUS-C; IUS-P; Comer et al., 2009*)*, a 27-item questionnaire assessing children's tendency to experience negative emotions, behaviors, and cognitions when confronted with uncertain situations and events. Comer et al. (2009) adapted the 27-item English version of the adult IUS for use in children (Buhr & Dugas, 2009; Freeston et al., 1994). The IUS-C has strong internal consistency and convergent validity in TD youth (Comer et al., 2009). The authors of the present study modified the parent and child versions of the IUS to accommodate common language and comprehension difficulties in children with ASD (21 of 27 original items modified). Some of the modifications included re-wording items from passive to active voice (e.g., changed "Surprise events upset me greatly." to "I don't like to be surprised by new plans or activities."), and consistently using first person pronouns to reduce abstraction and increase personalization (e.g., changed "One should always think ahead to avoid surprises." to "I always try to think ahead in order to avoid surprises."). In the present study, the participants

completed a practice question with assistance from the administrator. Additionally, the original 5-point Likert scale was changed to a 4-point scale to minimize complexity. Response options included: 1 = Never true, 2 = Sometimes true, 3 = Almost always true, 4 = Always true. Total scores range from 27 to 108. A parallel parent-report version of the Intolerance of Uncertainty Scale (IUS-P), which reports on children's experiences, was also administered. The modified IUS scales had good to excellent internal consistency in a sample of children with ASD and co-occurring anxiety disorders (IUS-P $\alpha = 0.96$, IUS-C $\alpha = 0.89$; Keefer et al., 2016). Internal consistency for the modified IUS child and parent was found to be good to excellent in the present study (α's = .84, .95, respectively).

ASD Related Independent Variables—Four ASD variables were examined as predictors of IU. These include a categorical diagnosis of ASD as well as three continuous ASD variables: social communication deficits, repetitive behaviors, and ED. The presence or absence of an ASD diagnosis was established by the ADOS (Lord et al., 2012) and ADI-R (Lord et al., 1994).

Severity of social communication deficits was assessed using the Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012). The SRS is a 65-item parent-report measure with items that are rated on a 4-point Likert scale (1 = not true, 2 = sometimes true, 3 = often true to 4 = almost always true). The SRS has strong measurement properties in ASD and TD populations (Constantino et al., 2004) and good convergence with ASD diagnostic interviews and inter-rater reliability (Constantino et al., 2003). Further, recent research suggests that the SRS measures a construct that is distinct from anxiety (Constantino et al., 2003; Renno & Wood, 2013). The Social Communication Index (SCI), which is a composite score measuring the severity of deficits in social communication and social reciprocity, was utilized in the present study.

Repetitive behavior severity was measured using the Repetitive Behavior Scale-Revised (RBS-R; Lam & Aman, 2007), a 44-item parent-report measure with strong internal consistency and inter-rater reliability (Lam & Aman, 2007) and replication of its factor structure (Lam & Aman, 2007; Mirenda et al., 2010). The RBS-R consists of six subscales including: Stereotyped Behavior, Self-Injurious Behavior, Compulsive Behavior, Routine Behavior, Sameness Behavior, and Restricted Behavior, and provides a total score. Items are rated on a 4-point Likert scale (0 = behavior does not occur, 1 = behavior occurs and is a mild problem, 2 = behavior occurs and is a moderate problem, 3 = behavior occurs and is a severe problem). The RBS-R Total Score was utilized in the present study.

ED was measured using the Emotion Control subscale of the Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2000). The BRIEF is an 86-item parent-report measure designed to assess eight facets of executive functioning: Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor. The BRIEF has adequate test-retest reliability, internal consistency, content, and convergent validity (Gioia et al., 2000). Items are rated on a 3-point Likert scale (1 = Never, 2 = Sometimes, 3 = Often). Raw scores were transformed into standardized T-scores, which were used in the analyses. Higher T-scores are indicative of greater impairment. The Emotion Control subscale of the BRIEF was designed to measure an individual's ability to

modulate or control his or her emotional responses (Gioia et al., 2000) and has been utilized as a measure of ED in many studies across a variety of populations (e.g., Qian et al., 2016, Wilde et al., 2012).

Control Variables—The Screen for Childhood Anxiety Related Disorders: Child and Parent Versions (SCARED-C and SCARED-P; Birmaher et al., 1999). The SCARED is 41-item screener for symptoms of anxiety with five anxiety subscales (Panic Disorder, Generalized Anxiety Disorder, Separation Anxiety Disorder, Social Anxiety Disorder, and School Avoidance). This scale has strong psychometric properties in TD children (Birmaher et al., 1999) and shows adequate internal consistency for both parent and child report in youth with ASD (Keefer et al., 2016; Reaven et al., 2009). Items were rated using a 3-point Likert Scale (0 = not true or hardly ever true, 1 = somewhat true or sometimes true, 2 = very true or often true). These scales were not modified for this study. Age, gender, and the Verbal Comprehension Index from the WISC-IV (Wechsler, 2004) were also included as control variables.

Data Analyses

Descriptive statistics were examined for all key study variables. Normality assumptions for variables and multiple linear regressions were examined. Shapiro-Wilk tests were significant and indicated non-normality and therefore non-parametric tests were conducted for all analyses.

A Wilcoxon Mann-Whitney U test was run to examine group differences by ASD status in levels of IU and anxiety (Aim 1, Table 2). Spearman's Rho correlations were examined to explore the relationship between measures of IU, anxiety, and ASD variables in the ASD group (Aim 2, Table 3). The strength of the correlations was defined as small for values less than 0.3, medium for values of 0.3-0.5, and large for values over 0.5 (Cohen, 1992). Bonferroni correction was used to adjust for multiple comparisons and decrease Type 1 error. Thus, for these correlational analyses, our a-priori alpha was set at $p < .005$.

Hierarchal linear regression models with bootstrapping (1,000 iterations) were run to examine whether ASD variables (ASD diagnosis and three ASD continuous variables) were predictive of IU when controlling for anxiety (Aim 3). For Aim 3, both ASD and TD groups were included in the analyses to maximize sample size since the combined sample yielded similar results to the analyses using only the ASD sample. For models examining the predictive value of continuous ASD variables, only parent report anxiety and IU data were included in the regression analyses because the ASD variables were based on parent report. Additionally, several authors have recommended the use of parent or composite report rather than child report alone due to concerns about the validity of self-reporting of emotional symptoms in youth with ASD (e.g., Mazefksy, Kao, & Oswald, 2011; Russell & Sofronoff, 2005; Storch et al., 2012). For all models, age, gender, and verbal cognition (i.e., VCI score) were entered in the first step as covariates. Anxiety was entered in the second step, and ASD variables were entered into the third step. An initial model was run to explore the relationship between IU and ASD diagnosis. Subsequent models with continuous ASD variables examined the severity of social communication deficits (SRS-2 SCI *T*-score,

Model 1), repetitive behavior severity (RBS-R Total Score, Model 2), and ED (BRIEF Emotion Control, Model 3). The final model (Model 4) included all three continuous ASD variables to determine which variable was the strongest predictor of IU when controlling for anxiety. In this model, age, gender and VCI were entered in the first step, followed by parent-reported anxiety in the second step. ED (BRIEF Emotion Control) was entered as the third step and RBS-R Total Score and SRS Social Communication Index T-Score variables were added in the fourth and fifth steps, respectively. The change in R^2 (ΔR^2) was an indicator for variance explained by the addition of predictors into the hierarchical regression. Multicollinearity statistics were run for all regression models, and variance inflation factor and tolerance statistics were within the acceptable range for all models.

Results

Aim 1. To Examine Group Differences in Levels of IU and Anxiety (Table 2)

Children in the ASD group had significantly higher parent ($z = -5.04$, $p < .001$) and child ($z = -3.69$, $p < .001$) reports of IU compared to the TD group.

Compared to the TD group, the level of anxiety in the ASD group was significantly higher according to parent report ($z = -3.54$, $p < .001$) but not significantly higher according to child report ($z = -1.90$, $p = .10$).

Aim 2: To Examine whether IU is Correlated with Anxiety and ASD Variables (Table 3)

For all correlations, significance was established a priori at $p < .005$ to account for multiple analyses. Moderate relationships were present between IU and anxiety based on child ($r = .46$) and parent ($r = .40$) reports, with both being significant at $p < .005$.

Based on parent report, a weak nonsignificant relationship was present between IU and the severity of social communication deficits whereas moderate and significant relationships were present between IU and ED ($r = .57$) and between IU and repetitive behaviors ($r = .46$).

Aim 3. To Examine which ASD Variables Predict IU (Table 4)

The presence of an ASD diagnosis was predictive of IU over and above the effects of anxiety. ($B = 10.26$, $p < .001$). When examining the contributions of ASD continuous variables, severity of social communication deficits (Model 1) and repetitive behavior severity (Model 2) were significantly associated with parent-reported IU, when controlling for anxiety (social communication deficits: $B = .25$, $p = .001$; repetitive behaviors: $B = .27$, $p = .002$). Similarly, ED ($B = 0.47$, $p < .001$) also significantly predicted parent-reported IU when controlling for anxiety (Model 3).

When all continuous ASD variables were entered together, results showed that ED ($B = 0.38$, $p < .001$) but not severity of social communication difficulty or repetitive behaviors was predictive of IU when controlling for anxiety (Model 4).

Discussion

This study sought to deepen our understanding of IU in youth with ASD by replicating previous findings and exploring novel relationships between IU and various ASD features. Consistent with previous research, we found that youth with ASD have elevated levels of IU compared to TD youth according to both parent and child report (Boulter et al., 2014; Chamberlain et al., 2013; Neil et al., 2016). As expected, we also found positive correlations between IU and anxiety, which is analogous to the relationship observed in TD children (e.g., Boelen et al., 2010).

This study was novel in its exploration of the relationship between IU and ASD separate from the effects of anxiety. Neil et al. (2016) is the only other study that examined the relationship between IU and a feature of ASD when controlling for anxiety and found that IU was predictive of sensory sensitivities irrespective of anxiety. Our study found that several other ASD features (i.e., repetitive behaviors, social communication deficits, ED) were related to IU when controlling for anxiety. Findings indicate that although research shows that anxiety and IU are highly correlated in both ASD and TD youth, IU also appears to be associated with both the categorical diagnosis of ASD as well as individual features of ASD. Specifically, having more severe social communication deficits, repetitive behaviors, and ED increases the risk for IU. These results suggest that IU appears to have a unique relationship with multiple ASD features, which may contribute to the high rates of IU observed in this population (e.g., Boulter et al., 2014).

Our findings indicate that ED was the only ASD variable that was predictive of IU when controlling for anxiety when all ASD variables were entered into the model. ED is considered to be a transdiagnostic risk factor for psychopathology (McLaughlin et al., 2011) and an intrinsic feature of ASD that is pathophysiologically linked to psychiatric comorbidity in this population (Mazefsky et al., 2013). Youth with ASD and ED may have experiences in which they perceive uncertain stimuli or circumstances as particularly distressing. This could in turn contribute to attempts to avoid uncertainty, thereby leading to fear conditioned responses to uncertain situations. Heightened physiological arousal may also be present in ED (Zantinge et al., 2017), which may compromise recruitment of adaptive emotion regulation strategies and lead to dysregulated reactions such as tantrums, aggression, or self-injury (Mazefksy et al., 2013).

One hypothesis for the relationship between IU and various features of ASD is that in some children, common susceptibility genes give rise to both IU and the features of ASD. Preliminary evidence suggests that relationships between ASD symptoms and IU may be heritable. Uljarevic and colleagues (2015) found that sensory abnormalities, IU, and anxiety were interrelated in mothers of youth with ASD. Additional evidence for potentially common mechanisms comes from neurobiological evidence, which reveals shared overlapping networks implicated in both ASD and IU. Neuroimaging findings show altered connectivity amongst several limbic regions, notably involving the anterior insula (Caria and Falco, 2015), a region is implicated in the anticipation of threatening events (Simmons et al., 2008), emotional salience, monitoring and awareness of self and others (Uddin & Menon, 2009), and regulation of emotions in youth with ASD (Pitskel et al., 2015). Although this

cross-sectional study examined if ASD variables predicted IU, it is also possible that the directionality between these constructs could be reversed such that IU could give rise to certain features of ASD, such as ED, or that ASD and IU could arise simultaneously in some affected individuals.

A direct relationship between IU and features of ASD has important clinical implications. Keefer et al. (2016) found that high levels of pretreatment IU compromised response rates to modified cognitive behavioral therapies (CBT) for anxiety. This suggests that incorporating IU specific modules into modified CBT protocols could enhance treatment response for youth with ASD and anxiety. Furthermore, if IU is related to ASD, IU may represent a treatment target that could prevent the development of emotional and behavioral disorders experienced by individuals with ASD (Rodgers et al., 2016).

Similar to most previous studies of IU in ASD, this study utilized the IUS, a self-report rating scale that focuses on two themes, cognitive uncertainty about the future and behavioral paralysis. However, it is possible that IU presents differently in ASD. For example, Chamberlain and colleagues (2013) found that individuals with ASD who were not clinically anxious exhibited heightened physiological reactivity compared to TD individuals when engaged in a paradigm that elicited uncertainty. This suggests that in some individuals, IU may be characterized by physiological or behavioral responses in addition to cognitive features. Novel studies measuring behavioral, physiological, and cognitive responses to uncertainty will allow us to better characterize the phenotype of IU in different types of individuals with ASD.

This study has several limitations. Sample limitations include a higher IQ in the TD group compared the ASD group. However, all participants in the study had an IQ > 80 and IQ (VCI) was controlled for in all analyses. The sample was also relatively small, which increases the likelihood of Type 2 error.

Other limitations pertain to the measures used in this study. The IUS is not validated in youth with ASD. Current and prior data, however, show acceptable internal consistency of the modified measure (Keefer et al., 2016), and the IUS-P has been utilized in multiple studies of youth with ASD (Boulter et al., 2014; Chamberlain et al., 2013; Neil et al., 2016). The SCARED has been used in prior studies of children with ASD (e.g., Blakeley-Smith et al., 2012; Lohr et al., 2017; Stern et al., 2014); however, there are concerns about children's' ability to self-report and the specificity of anxiety screening measures with this population (Kerns et all, 2015). It is also possible that there may be some measurement overlap between the IUS and SCARED; however, an item level comparison revealed that the SCARED included anxiety-specific symptoms of physiological arousal, somatic symptoms, and avoidance/refusal of specific situations (e.g., school) that were not included in the IUS. Future research is needed to examine potential overlap between the constructs of IU and anxiety in ASD.

Another point to note is that the anxiety measures (i.e., SCARED, DICA) used in this study are DSM-based and therefore do not capture atypical anxiety presentations in ASD. Atypical anxiety symptoms are linked to core ASD deficits and include anxiety about sensory stimuli,

anxiety about changes in routine, and anxiety in social situations related to unpredictability rather than fear of negative evaluation (Kerns & Kendall, 2012). These symptoms may be captured by measures of ASD and may overlap with some items on the IUS, which could account for the association between ASD variables and IU. Measures to assess atypical anxiety symptoms were developed following the completion of this study and can be incorporated in future work (Kerns et al., 2016). Another consideration is that the interrelationships between anxiety, ASD variables, and IU may differ if a clinically anxious sample was recruited. Thus, replication of this study with a well-characterized clinically anxious ASD sample is necessary.

Finally, each of the ASD variables had a small effect on IU, and together with anxiety, our models accounted for only about 50% of the variance in IU. This suggests that much of the variance in IU is largely unexplained. In future work, other factors will need to be considered including genetic, biological, and psychosocial contributions.

In summary, this study confirms the high levels of IU in cognitively-able youth with ASD. Novel to this study were the findings that IU may have a relationship with both anxiety and multiple aspects of ASD, in particular ED. Further research is needed using larger sample sizes and more objective assessments in order to better understand the nature of IU in ASD.

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Table 1

Demographic and Clinical Characteristics of ASD and TD Participants

	ASD (*n* = 57)	**TD (*n* = 32)**	
	M (SD)		*P*
Age	10.94 (2.01)	9.85 (1.12)	.095
FSIQ	100.86 (14.88)	116.34 (9.16)	<.001
VCI	106.68 (16.72)	120.34 (10.11)	<.001
PRI	105.49 (12.55)	113.69 (9.99)	<.001
SRS-2 SCI	74.91 (10.42)	44.81 (5.46)	<.001
RBS-R Total Score	25.35 (17.90)	1.06 (3.24)	<.001
BRIEF EC	67.02 (10.21)	44.45 (6.42)	<.001
	n (*%* Total)		
Male	47 (82.5%)	26 (81.3%)	
ADHD	35 (61.4%)		
Anxiety Disorder	20 (35%)		
SAD	1 (1.8%)		
GAD	5 (8.8%)		
SoP	11 (19.3%)		
OCD	7 (12.3%)		

Note. FSIQ = Full Scale IQ, VCI = Verbal Comprehension Index, PRI = Perceptual Reasoning Index. SRS-2 SCI = Social Responsiveness Scale, Second Edition Social Communication Index, RBS-R Total Score = Repetitive Behavior Scale, Revised Total Score, BRIEF EC = Behavior Rating Inventory of Executive Function Emotion Control scale. All psychiatric disorders were assessed using the DICA (Diagnostic Interview for Children and Adolescents): ADHD = Attention Deficit/Hyperactivity Disorder, SoP = Social Phobia, OCD = Obsessive Compulsive Disorder, GAD = Generalized Anxiety Disorder, SAD = Separation Anxiety Disorder.

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Table 2

Descriptive Statistics for IU and Anxiety (means and SD)

	ASD (*n* =57)	TD (*n* = 32)	*p*
IU			
IUS-C**	52.71 (15.15)	41.41 (8.21)	<.001
IUS-P**	47.20 (11.69)	34.29 (6.99)	<.001
Anxiety			
SCARED-C	24.30 (15.18)	19.59 (13.27)	.10
SCARED-P**	18.44 (11.71)	9.26 (8.69)	<.001

IUS: Intolerance of Uncertainty Scale; SCARED: Screen for Child Anxiety and Related Disorders.

Table 3

Spearman's Rho Correlations of IU with Anxiety and ASD Variables within the ASD (n = 51) and TD (n = 28) Groups

	IUS - C	
	ASD	**TD**
Child Report		
SCARED	.46†	.36
Parent Report		
SCARED	.40†	.71†
SRS-2 SCI	.16	.06
RBS-R Total Score	.43†	.47*
BRIEF EC	.48†	.08

*p=.01

†p = .005 (Bonferroni correction for multiple comparisons)

SCARED-P: Screen for Child Anxiety and Related Disorders-Parent Report; RBS-R: Repetitive Behavior Scale - Revised; SRS-2 SCI: Social Responsiveness Scale, Second Edition Social Communication Index; BRIEF EC: Behavior Rating Inventory of Executive Function (BRIEF) Emotion Control.

Table 4

Hierarchical Regressions with Anxiety and ASD Variables Predicting IU (n = 73)

	Model 1			Model 2			Model 3			Model 4		
	B (SE (B))	**P**	**Δ R^2**	**B (SE (B))**	**P**	**Δ R^2**	**B (SE (B))**	**P**	**Δ R^2**	**B (SE (B))**	**P**	**Δ R^2**
Step 1			.04			.04			.04			.04
Age	0.23 (0.64)	0.72		0.71 (0.60)	0.24		0.12 (0.63)	0.85		0.13(0.70)	0.85	
Gender	−0.80 (2.91)	0.78		−0.80 (2.73)	0.77		−1.54 (2.60)	0.55		−1.76(2.54)	0.49	
VCI	0.08 (0.07)	0.27		0.04 (0.07)	0.55		0.02 (0.06)	0.69		0.06(0.07)	0.41	
Step 2			.38**			.38**			.38**			.38**
SCARED-P	0.51 (0.11)	<0.001		0.48 (0.14)	0.003		0.44 (0.10)	<0.001		0.38 (0.13)	0.003	
Step 3			.09**			.09**			.18**			
BRIEF EC	–	–		–	–		0.47 (0.08)	<0.001		0.38 (0.10)	<0.001	.18**
RBS	–	–		0.27 (0.09)	0.002		–	–		0.12 (0.69)	0.18	.02
SCI	0.25 (0.08)	0.001		–	–		–	–		0.05 (0.09)	0.56	.002

Note.

*$p < .05$,

**$p \leq .001$

SCARED-P: Screen for Child Anxiety and Related Disorders-Parent Report; RBS-R: Repetitive Behavior Scale - Revised; SRS-2 SCI: Social Responsiveness Scale, Second Edition Social Communication Index; BRIEF EC: Behavior Rating Inventory of Executive Function (BRIEF) Emotion Control.