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ORIGINAL PAPER

Structural and Pragmatic Language in Children with ASD: Longitudinal Impact on Anxiety and Externalizing Behaviors

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Abstract Children with autism spectrum disorder (ASD) are at heightened risk for developing comorbid psychological disorders, including anxiety disorders, which may be further exacerbated by the presence of externalizing behaviors. Here, we examined how structural language and pragmatic language predicted anxiety and externalizing behaviors. Participants were 159 young children (4–7 years old) with ASD and their mothers. Utilizing structural equation modeling we examined associations among structural language, pragmatic language, anxiety symptoms, and externalizing behaviors. Pragmatic language, was inversely related to child anxiety and co-occurring externalizing behaviors. Structural language skills positively predicted child anxiety. These findings suggest that children with ASD may be at heightened risk for anxiety and externalizing disorders due to their pragmatic language deficits.

Keywords Anxiety · Language · Autism spectrum disorder

Introduction

Anxiety disorders are prevalent in about 40% of youth under the age of 18 years with an autism spectrum disorder (ASD) (Jennett et al. 2013), in contrast to the prevalence rate of approximately 10% in the general population of children with neurotypical development (Costello et al. 2011). Though in children with ASD it is difficult to differentiate symptoms of anxiety from core symptoms of ASD, due to the overlap between anxiety and the diagnosis of ASD, many children with ASD experience a significant number of anxiety symptoms independent of their ASD symptomotology (Jennett et al. 2013). It remains unclear whether or not anxiety manifests itself similarly in children with ASD and in children who are typically developing (TD). Researchers have differentiated between *typical* and *atypical* presentations of anxiety in youth with ASD. *Typical* anxiety has been defined as that which is consistent with the DSM criteria. *Atypical* anxiety, on the other hand, has been defined as symptomatology that does not meet the DSM definition, but that may uniquely reflects anxiety in children with ASD (Kerns et al. 2014). Kerns and colleagues (2014) found that traditional anxiety disorders were present in 48% of their sample of children with ASD, while 15% presented with atypical anxiety. Additionally, research has suggested that children with high-functioning ASD experience higher levels of anxiety than children who are lower functioning (Bellini 2004; Weisbrot et al. 2005; White et al. 2009). There is still much to be learned regarding the manifestations of anxiety in children with ASD.

Structural Language and Anxiety

The influence of language on the development of anxiety disorders has been understudied in children with ASD. In particular, the association of structural language—defined here as articulation, phonology, and syntax—has been underexamined in relation to anxiety symptoms for these children. In typically developing (TD) children, language and speech difficulties in early childhood have been associated with higher levels of anxiety symptoms in early

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childhood, middle childhood, and into adolescence (Beitchman et al. 2001; Cantwell and Baker 1987). Children who experience speech and language difficulties often experience early peer rejection, which is likely to lead to fears of embarrassment or humiliation (Asher and Gazelle 1999). This is likely to result in avoidance of such situations, ultimately increasing the likelihood of developing anxiety. In children with ASD, on the other hand, the reverse pattern has been found. In a sample of children with ASD or TD, ages two through 14 years old, children with ASD who had higher verbal communication abilities experienced more anxiety, whereas the opposite trend was observed in TD children (Davis et al. 2011). The association between higher language ability and increased levels of anxiety has also been found in very young children with ASD. In a study of infants and toddlers with ASD, increased receptive language abilities were shown to be positively associated with child anxiety scores (Davis et al. 2012). It may be that, even among young children with ASD, those who have higher language ability are more able to comprehend negative information that is transmitted by others, and this may translate into anxiety.

Pragmatic Language and Anxiety

Prior studies of TD children have found that anxious children have higher rates of difficulties with pragmatic language (Halls et al. 2015; van Steensel et al. 2013), which by definition differs from basic structural language skills. Pragmatic language involves nonverbal communication, conversation initiation and maintenance; whereas structural language is a narrower category of skills that includes syntax, articulation, and phonology. Few studies have longitudinally examined the association between pragmatic language and anxiety. However, a twin study found that "autistic-like" communication difficulties (e.g. lack of turn-taking in conversations) at 7 years old predicted internalizing traits at 12 years old in TD children (Hallett et al. 2010). This is concerning given that pragmatic language deficits are a core trait in individuals with ASD (APA 2013). Further, one study found that pragmatic language deficits, but not structural language deficits, were positively related to concurrent internalizing behaviors in 6- to 12-year-old children with ASD (Boonen et al. 2014). Pragmatic language impairments may lead a child to misperceive others in social situations, which may cause difficulties in achieving social goals. These social difficulties are therefore likely to result in feeling insecure and inevitably contribute to increased anxiety (Coplan and Weeks 2009; Mazurek and Kanne 2010). There is a need for further research examining the role pragmatic language plays, above and beyond structural language, in the development of anxiety in young children with ASD. The present study expands on the existing literature by longitudinally examining the effect of pragmatic language and structural language on anxiety in young children with high-functioning ASD.

Externalizing Behaviors and Anxiety

Children with ASD also present with higher levels of externalizing behaviors when compared to their TD peers; these behaviors include aggression, hyperactivity, and rule-breaking behaviors (e.g., Baker and Blacher 2015; Kanne and Mazurek 2011; Simonoff et al. 2008). Research examining the prevalence of disruptive behavior disorders in children with ASD report that as many as one in every four children have a comorbid disruptive behavior disorder (Matson et al. 2009). Not surprisingly, research has demonstrated that children with ASD who present with co-occurring disruptive behaviors, are at even greater risk for heightened symptom severity of anxiety, and have an attenuated response to treatment relative to those without comorbid disruptive behavior problems (Storch et al. 2012). It also appears that anxiety symptoms, in turn, predict rates of externalizing behaviors in children with ASD. Researchers have found that infants and toddlers with ASD who have higher anxiety symptom severity display higher rates of challenging behaviors (Cervantes et al. 2013). It is likely that these children utilize disruptive behaviors in order to avoid exposure to anxiety provoking situations. This likely further reinforces the use of disruptive behaviors as a coping mechanism, while at the same time increasing symptoms of anxiety (i.e. avoidance). It is therefore important to take into account co-occurring externalizing behaviors when examining anxiety symptoms in young children with ASD.

Structural Language, Pragmatic Language, and Externalizing Behaviors

Research findings examining the association between global language (which incorporates both pragmatic language and structural language) and externalizing behavior problems in children with ASD have been mixed. Children with ASD who are aggressive have been found to display higher levels of receptive and expressive language difficulties than non-aggressive children (Mazurek et al. 2013). Likewise, pragmatic language difficulties have been found to be positively associated with externalizing behaviors (Boonen et al. 2014). It is possible that children with ASD become frustrated due to their inability of communicating their needs, and therefore resort to displaying externalizing behaviors. On the other hand, there have also been several studies suggesting that global language deficits are not associated with higher levels of externalizing behaviors (for review see Kaat and Lecavalier 2013). These conflicting

findings, which primarily involve studies that have collapsed multiple language domains into a global language measure, suggest that a more nuanced approach to language may be required. The present study examined structural language and pragmatic language in relation to externalizing behaviors as they present in high-functioning children with ASD. We focused on children without intellectual disability (ID) due to the fact that prior research has found comorbid psychopathology in individuals with ASD differs based on whether ID is present (Matson and Shoemaker 2009). Therefore, we thought it would be appropriate to examine these processes in children with high-functioning ASD as an initial step.

Research Questions and Hypotheses

Thus, the primary aim of this study was to examine whether structural language and pragmatic language can predict anxiety and co-occurring externalizing behaviors in young children with ASD, in the absence of intellectual disability (ID). We examined the following research questions: (1a) to what extent does structural language relate to child anxiety in young children with ASD over time, while accounting for child cognitive ability? (1b) To what extent does pragmatic language relate to child anxiety in young children with ASD over time, while accounting for child cognitive ability? (2a) To what extent does structural language relate to child externalizing behaviors in young children with ASD over time, while accounting for child cognitive ability? (2b) To what extent does pragmatic language relate to child externalizing behaviors in young children with ASD over time, while accounting for child cognitive ability?

Based on prior research, we expected that structural language would relate positively to anxiety levels in young children with ASD (e.g. Davis et al. 2011). We also expected that pragmatic language would be inversely related to child anxiety. Finally, given the mixed research findings regarding the relationship between language and externalizing behavior problems, we set out to examine this association in an exploratory manner.

Methods

Participants

Participants were 159 children with ASD, ages 4–7 years (82% male) and one parent per child (85% biological mothers) who were recruited for a larger study examining the transition to early schooling for children with ASD and their families. More than half of parent respondents were married (80%), had at least a 4-year college degree (63%), and had annual household incomes above $65,000 (56%). At the time of study enrollment, children were 5 years 6 months old on average. Children were in preschool (38%), kindergarten (27%), first grade (24%), and second grade (11%). Child race was based on an open-ended parent-report item later aggregated into categories; the majority of participants were non-Latino white (57%), followed by bi- or multi-racial children (21%), Latino (10%), Asian (5%), African-American (3%), and other (4%). English was their primary spoken language. For the present analyses, children were included in this study if their Full Scale IQ was above 70 (mean = 93.5, SD = 13.4), indicating no intellectual disability (ID).

Procedures

This study took place at two major universities, and was approved by the Institutional Review Boards of the participating universities. During the summer or early fall, an initial eligibility session was held in order to determine study eligibility, in which graduate student researchers trained in the study procedures met with the child and parent at research offices in southern California or metropolitan Massachusetts. The Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2000) and a three-subtest battery of the Wechsler Preschool and Primary Scales of Intelligence (WPPSI-III; Wechsler 2002) were utilized to confirm ASD diagnosis and to determine whether the child met the IQ criteria for participation. In cases where the child had not already received a diagnosis of ASD from a non-school autism professional, the autism diagnostic interview-revised (ADI-R; Lord et al. 1994) was also administered to the parent. Eligible participants for the larger study had to (a) score in the autism or autism spectrum range on the ADOS, (b) have an estimated IQ score of 50 or higher on the WPPSI-III (only those scoring 70 or higher were included in the present analyses), (c) either have had a previous diagnosis of ASD from an out-of-school clinician or scored in the autism or autism spectrum range on the ADI-R, and (d) be between ages 4–7 years and entering elementary school or their final year of preschool in the fall.

Children and their parents visited the research offices for three subsequent sessions: during the fall (Time 1), the spring roughly 6 months later (Time 2), and the spring of the following school year (Time 3; not utilized in the present analyses). These assessment sessions included child assessments at a research office, parent-completed questionnaires and semi-structured interviews, and teacher-completed questionnaires. Participants received an honorarium at each visit in appreciation for their participation. The current study examined data from the eligibility visit, Time 1, and Time 2. For simplification purposes, from here on forward we will include measures taken at the eligibility

session as part of Time 1, since these two assessments were within 0–3 months of each other.

ASD Diagnosis

At the initial eligibility session, all children were assessed with the Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2002). The ADOS is a semi-structured observation schedule designed to assess social interaction, communication, play and imaginative use of materials, and restricted and repetitive behaviors in individuals who may have an ASD. Behaviors are scored and a standardized diagnostic algorithm is applied. Children are classified as either autism, autism spectrum, or not on the autism spectrum; children who were eligible fell in the autism or autism spectrum range.

Wechsler Preschool and Primary Scales of Intelligence-III (WPPSI-III; Wechsler 2002)

Children's cognitive ability was measured using the WPPSI-III. The WPPSI yields an IQ score (M = 100 and SD = 15). A calculated Full Scale IQ was computed from an abbreviated WPPSI-III, using the matrix reasoning, vocabulary and picture completion. This three-subtest version of the WPPSI-III has established reliability ($r = .95$) in its estimation of cognitive skills (Sattler and Dumont 2004).

Children's Communication Checklist (CCC-2; Bishop 2006)

Parents completed the CCC-2 during the initial eligibility session. The CCC-2 is a 70-item parent questionnaire broken into ten scales, each with seven items. It assesses structural language and pragmatic skills in children ages 4–16 years. Items are rated based on the frequency of each behavior, with options ranging from 0 (less than once a week or never) to 3 (several times a day or always). The syntax and speech subscales were utilized as two of our three indicator variables in the structural language factor. A composite score measuring pragmatic aspects of communication was used as an indicator variable of the pragmatic language factor, which was made by summing the following subscales: initiation, stereotypic language, use of context, and nonverbal communication. Prior work has utilized the same composite of child pragmatic language by summing the standardized subscale scores (Boonen et al. 2014). Internal consistency reliability coefficients for the CCC-2 have been shown to range from .77 to .85 for all subscales across age groups (Bishop 2003).

Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk 1999)

The CASL was administered to children during the Time 1 assessment session. The CASL is a standardized assessment of language skills that is administered to children, ages 3–21 years, by an examiner. The CASL is a widely used assessment of lexical/semantic, syntactic, and pragmatic language. The syntax subscale was utilized in our analyses as indicator of the structural language latent factor. The CASL has good construct validity and strong reliabilities of .90 to .96 on each of the three indices (M = 50, SD = 10).

Social Responsiveness Scale (SRS; Constantino and Gruber 2005)

The Social Responsiveness Scale was completed by parents at the Time 1 assessment session. The SRS is a 65-item parent questionnaire that assesses behaviors associated with ASD. Items are rated on a four-point scale from 1 (not true) to 4 (almost always true). The t-score of the subscale for social communication was utilized as an indicator for the pragmatic language latent factor. Total t-scores of 60–75 indicate clinically significant deficiencies in social communication, often typical of children with mild ASD. Total t-scores above 76 are suggestive of severe interference in day-to-day social communication, and are strong indicators of a clinical diagnosis of ASD. The SRS has been shown to have good construct validity and good internal consistency with alphas ranging from .93 to .97.

Social Skills Improvement System (SSiS; Gresham and Elliott 2008)

Parents completed the parent form of the SSiS during the Time 1 and Time 2 sessions. The SSiS is a 79-item questionnaire that provides a broad assessment of socials skills and problem behaviors. Items are rated on a four-point scale ranging from 1 (not true) to 4 (very true). We utilized the social communication subscale score from the Time 1 session as an indicator of the pragmatic language latent factor, and the hyperactivity/inattention and bullying behaviors subscales from the Time 2 session were used as part of an externalizing problems latent factor. The SSiS has good reliabilities with alphas ranging from .72 to .95 for parent report.

Child Behavior Checklist for Ages 1½–5 Years and Ages 6–18 Years (CBCL; Achenbach 2000; Achenbach and Rescorla 2001)

The present study utilized parents' reports on the CBCL from the Time 2 session. Two parent versions of the CBCL

were used depending on the child's age. Each item is rated on a 3-point scale: 0 (not true), 1 (somewhat or sometimes true), or 2 (very true or often true). The present study used t-scores for the anxiety problems and aggressive behaviors subscales to assess anxiety (as an observed variable) and externalizing problems (as part of the externalizing problems latent factor), respectively. The CBCL subscales have been shown to have good validity and internal consistency, with alpha coefficients ranging from .78 to .84.

Data Analytic Plan

Structural equation modeling was used to evaluate the fit of the proposed causal model of structural language and pragmatic language playing a role on the level of co-occuring anxiety and externalizing behavior problems in young children with ASD. Structural equation modeling allows simultaneous evaluation of links between measured variables and latent constructs, and of associations between latent constructs themselves. The Structural Language factor had parent report of child syntax on the CCC-2, lab assessment of child syntax on the CASL, and parent report of child speech on the CCC-2 as indicators. Pragmatic language had parent report of child social communication on the SSiS, parent report of child social communication on the SRS, and parent report of child pragmatics on the CCC-2 as indicators. Anxiety was measured utilizing an observed variable of parent report of child anxiety symptoms on the CBCL. Externalizing Behaviors had parent report of child aggressive behaviors on the CBCL, parent report of child hyperactivity/inattention on the SSiS, and parent report of child bullying behaviors on the SSiS as indicators.

Next we tested the structural model shown in Fig. 1, in order to address our research questions; specifically we examined whether structural language and pragmatic language each related to anxiety and externalizing problems over time. Given the strong association between child cognitive ability and language and our desire to look specifically at language skills, we covaried child IQ by entering it as a predictor of Time 1 structural language and pragmatic language. We included paths from structural language and pragmatic language, measured at Time 1, predicting anxiety, measured at Time 2. We also included paths from structural language and pragmatic language, measured at Time 1, predicting externalizing behaviors, measured at Time 2. Lastly, we correlated the residuals of structural language and pragmatic language. We also correlated the residuals of anxiety and externalizing behaviors.

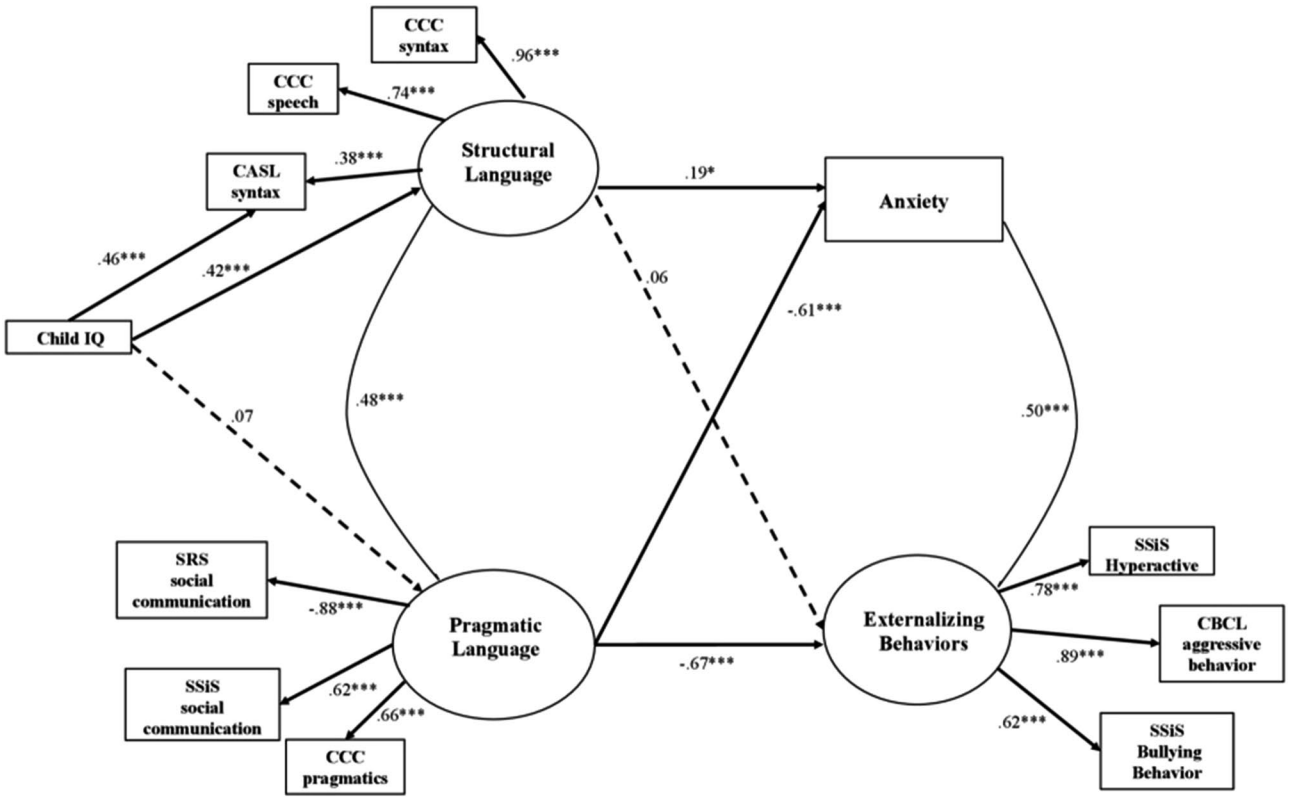

Fig. 1 Model predicting anxiety and eternalizing behaviors. *$p < .05$, ***$p < .001$, *dashed lines* are non-significant

Results

The model presented in Fig. 1 was tested utilizing Mplus Version 6 (Muthen and Muthen 2010). The intercorrelations among all of the variables entered into the model are presented in Table 1. The strength and statistical significance of each pathway were estimated. We used full information maximum likelihood (FIML) estimation and testing to account for missing data; FIML has been demonstrated to be a robust estimator (Enders and Bandalos 2001; Schlomer et al. 2010). All pathways between the latent variables and the indicators were significant at $p < .001$. Additionally, three indices of good model fit were examined: a Chi-square test of fit (non-significant Chi-square values generally reflect good to excellent fit), a comparative fit index (CFI; values above 0.90 indicate good fit), and the root mean square error of approximation (RMSEA; values at or below 0.05 = excellent fit, 0.05–0.09 = good fit, and over 0.10 = inadequate fit) (Hu and Bentler 1999). The overall proposed model showed good fit; CFI = 0.98, RMSEA = 0.04, x^2 (37, 159) = 44.24, $p = .19$.

As shown in Fig. 1, child cognitive ability (IQ) was significantly related to child structural language ($\beta = .042$, $p < .001$); however, it was not significantly related to child pragmatic language. Child cognitive ability was also significantly related to child syntax ($\beta = .402$, $p < .001$). There was a significant correlation between the residuals of structural language and pragmatic language, r (159) = .408, $p < .001$. There was also a significant correlation between the residuals of anxiety and externalizing behaviors, r (159) = .500, $p < .001$.

In regard to research question 1a, whether child structural language related to child anxiety over time, child structural language at Time 1 significantly predicted child anxiety at Time 2 ($\beta = .019$, $p < .05$); children with initially higher structural language abilities had higher levels of anxiety at the follow-up time point. Regarding research question 1b, whether child pragmatic language was significantly related to child anxiety over time, pragmatic language at Time 1 was inversely related to child anxiety at Time 2 ($\beta = -.601$, $p < .001$). Children with higher levels of pragmatic language at the initial time point had lower levels of child anxiety at the follow-up time point, and those with initially lower levels of pragmatic language, had higher levels of child anxiety.

In regard to research question 2a, whether child structural language was significantly related to externalizing behaviors over time, child structural language at Time 1 was not significantly related to externalizing behaviors at Time 2. Regarding research question 2b, whether child pragmatic language related to externalizing behaviors over time, pragmatic language was inversely related to child externalizing behaviors ($\beta = -.067$, $p < .001$). Higher levels of pragmatic language at the initial time point predicted lower externalizing behavior levels at following time point, and lower initial levels of pragmatic language predicted higher externalizing behaviors at follow-up.

Discussion

This study examined longitudinal associations among two aspects of language (structural language and pragmatic language) and levels of anxiety and externalizing problems in young children with high-functioning ASD. Overall, in a combined structural model, pragmatic language negatively predicted both anxiety and externalizing symptoms over time, whereas structural language was a positive predictor of anxiety levels only. Additionally, we covaried for child cognitive ability and found that while cognitive ability was positively related to structural language skills, it did not significantly relate to pragmatic language abilities. This is

Table 1 Intercorrelation among variables entered in model

	1	2	3	4	5	6	7	8	9	10	11
1. Child IQ	1										
2. Speech	0.29***	1									
3. Syntax	0.41***	0.71***	1								
4. Ax. syntax	0.62***	0.43***	0.56***	1							
5. SSiS social communication	0.09	0.17	0.24**	0.07	1						
6. SRS social communication	−0.08	−0.33***	−0.38***	−0.09	−0.58***	1					
7. Pragmatics	0.02	0.28***	0.37***	0.12	0.41***	−0.54***	1				
8. Anxiety	0.12	−0.10	−0.09	0.14	−0.27***	0.47***	−0.35***	1			
9. Bullying subscale	0.01	−0.05	−0.02	0.03	−0.18*	−0.31***	−0.21**	0.39***	1		
10. Hyperactive/inattention	−0.01	−0.17	−0.17*	−0.09	−0.30***	−0.51***	−0.43***	0.54***	0.46***	1	
11. Aggressive behaviors	0.03	−0.26**	−0.24**	−0.09	−0.26**	0.50***	−0.37***	0.59***	0.58***	0.69***	1

*$p < .05$, **$p < .01$, ***$p < .001$

in line with prior research, which has found that nonverbal cognitive abilities do not significantly predict pragmatic language (e.g. Volden et al. 2009). Therefore, these findings indicate that IQ may be predictive of structural language in high-functioning children with ASD. Pragmatic language, on the other hand, may be associated with more nuanced cognitive processes, such theory of mind (Lam 2014).

We also observed that initial levels of structural language were positively related to later levels of child anxiety, such that children who had higher structural language abilities experienced more anxiety, and children with poorer structural language abilities experienced less anxiety. This is in line with prior research, which has also found an association between higher language ability and increased anxiety symptomatology in individuals with ASD (Davis et al. 2011, 2012). These findings suggest that perhaps children who have higher structural language ability are adept in comprehending negative social information, which may translate into anxiety. It may therefore be important to screen high-functioning children with ASD for anxiety disorders in order to intervene early on.

Further, we found that initial levels of pragmatic language skills were inversely related to later child anxiety levels, such that children with higher pragmatic language skills displayed lower anxiety levels, and children with lower pragmatic language skills displayed higher levels of anxiety. This is in line with findings examining the association between pragmatic language deficits and anxiety in children of typical development, which have also found that early pragmatic language deficits related to anxiety disorders in later childhood (Hallett et al. 2010). The present study extends these findings by indicating that high-functioning children with ASD who present with early pragmatic language difficulties also go on to have greater levels of anxiety over time. This also helps to further elucidate research which has found a concurrent association between pragmatic language difficulties and internalizing behaviors in individuals with ASD (Boonen et al. 2014). Coupled together, these results suggest that children with a discrepancy between structural and pragmatic language skills may be most at risk for experiencing anxiety. It appears that when structural language skills exceed pragmatic language skills, children are prone to developing anxiety symptoms. Further research examining how structural and pragmatic language capabilities interact with one another in predicting risk for anxiety symptoms is necessary. Additionally, these findings allude to the importance of addressing pragmatic language deficits early on for children with ASD. Intervening in order to promote pragmatic language in early childhood may decrease the risk for developing comorbid anxiety disorders in this population.

In our examination of the association between anxiety and externalizing behaviors we found that they were significantly related, i.e., children with anxiety were also likely to present with co-occurring externalizing behaviors. This is consistent with past research (e.g. Bubier and Drabick 2009; Drabick et al. 2008) and is concerning given that children with anxiety and comorbid externalizing behavior problems are at risk for increased symptom severity, and often their response to treatment is attenuated (Storch et al. 2012). Prior research has demonstrated that infants and toddlers with ASD who exhibit increased anxiety also present with more significant aggressive and destructive behaviors (Cervantes et al. 2013). The present findings suggest that this association between anxiety and externalizing behaviors extends to a sample of school aged children with ASD. Future research should further explore whether the relationship between anxiety and externalizing behaviors may be bidirectional. Additionally, anxiety interventions for children with ASD should aim to target both anxiety and co-occurring externalizing symptoms as they appear to exacerbate one another.

Our second set of research questions examined the extent to which structural language and pragmatic language longitudinally predicted externalizing behaviors. We did not find initial levels of structural language to be significantly related to later externalizing behaviors. In other words, structural language does not appear to be a unique predictor of child externalizing behaviors when accounting for pragmatic language skills in high functioning children with ASD. These findings help resolve the inconsistencies in past work on the topic, which have found mixed results, including some studies supporting a relationship between verbal abilities and externalizing behaviors (e.g. Estes et al. 2007; Mazurek et al. 2013), and others indicating that child verbal abilities are not related to externalizing behavior problems in children with ASD (e.g. Kaat and Lecavalier 2013).

Further, we found that initial levels of pragmatic language skills were inversely related to child externalizing behaviors. This is line with prior research that has also found pragmatic language difficulties to be associated with concurrent externalizing behaviors (Boonen et al. 2014). The present study extends these studies by indicating that children with early pragmatic language difficulties go on to have greater externalizing behavior problems over time. Pragmatic language deficits may hinder children from communicating their needs appropriately and may lead them to utilize increased externalizing behaviors in order to achieve their desired outcomes (Gallagher 1999; Ketelaars et al. 2010). This is particularly relevant for children with ASD given their increased difficulties with pragmatic language. Therefore, interventions targeting pragmatic language would also likely help in decreasing externalizing behavior problems in children with ASD.

Limitations and Future Directions

As in any study, there were limitations to this one, and we note them here. First, the present study was limited by the fact that we did not have information regarding whether children had a clinical diagnosis of an anxiety disorder, other than the scores on the instrument used herein. Second, we did not differentiate types of anxiety disorders. It might be helpful, as a next step, to examine the effects of structural language and pragmatic language in relation to the development of different types or subtypes of anxiety disorders. Further, our study relied on parent-report for several of the constructs examined, making shared method variance a limitation. Future research could examine either child language or behavior problems through observational measures. Additionally, one of our measures of pragmatic language, the social communication subscale of the SRS, contains a wider array of social behaviors beyond pragmatic language alone. Future research should examine these questions with more precise measure of pragmatic language. Our study was also limited in that it may not be representative of the ASD population at large given that a large number of families had higher levels of income and education. Therefore, future studies should seek to examine the current processes in a more diverse population of children with ASD.

Nonetheless, this is the first study to longitudinally examine the association between structural/pragmatic language and anxiety and co-occurring externalizing behaviors utilizing a structural model approach. In an attempt to examine the association between structural language, pragmatic language and co-occurring psychological disorders in young children with ASD, we found that pragmatic language and structural language longitudinally predicted child anxiety levels. Structural language positively predicted child anxiety, while pragmatic language was inversely associated with later child anxiety. We also found that pragmatic language, but not structural language, longitudinally predicted levels of externalizing behavior problems. As a next step, future research could examine the predictive value of language on change in anxiety and externalizing behaviors over time.

Implications for Practice

This study's findings underscore the importance of conducting assessments that examine language subdomains separately, rather than a more global assessment of language. This is particularly relevant given the findings that structural and pragmatic aspects of language contribute differently to emotional and behavioral outcomes. Indeed, the results of this study paired with the high documented rates of psychopathology among children with ASD (Jennett et al. 2013; Simonoff et al. 2008) suggest that such evaluations should also include an assessment of the child's socio-emotional functioning, including anxiety symptoms, which are less visible, in addition to the more observable externalizing symptoms. Additionally, early interventions targeting pragmatic language may have a positive collateral effect by decreasing anxiety, externalizing behaviors and the overall risk of comorbid psychopathology in children with ASD.

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Author Contributions NR developed the idea for this study, which was based on an ongoing longitudinal project [IES, R324A110086, Jan Blacher, PI], participated in its implementation, including data collection, analysis, and all aspects of manuscript preparation. AE, as co-PI, participated in interpreting the data and reviewing the manuscript; JB participated in reviewing the manuscript. All authors read and approved the final manuscript.

Compliance with Ethical Standards

Conflict of interest All 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.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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