Exploring Gender Differences in Autism-Spectrum-Related Developmental Areas

in 30-Month-Olds

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Senior Honors Thesis Department of Psychology and Neuroscience The University of North Carolina at Chapel Hill April 2017

A thesis presented to the faculty of The University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the Bachelor of Science degree with Honors in Psychology and Neuroscience.

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Acknowledgements

I would first and foremost like to thank my committee. I am deeply grateful to my advisor, Dr. Barbara Goldman, for her unyielding patience in and dedication to helping me develop and refine this honors project. Thanks to Dr. Goldman's assistance, this project has become one that I am very proud of. I am also extremely grateful to Dr. Rebecca Stephens for her time and interest in supporting my research endeavors over my years at UNC-Chapel Hill and for all of her assistance in conceptualizing and carrying out my honors project. Additionally, I very much appreciate Dr. Peter Ornstein's valuable feedback on my honors project and dedication to helping me improve this project. It is thanks to the above individuals that I was able to realize a successful project in my area of research interest.

I would also like to thank my family and friends for providing me with the support and resources that I needed to successfully complete a project of this scale. Without all of you there to cheer me on, I could never have accomplished something like this.

Abstract

Autism spectrum disorder (ASD) is a group of developmental disabilities often marked by social and behavioral impairments and repetitive, stereotyped behaviors. Closely related to this disorder is the concept of an "autistic continuum," which refers to the idea that all individuals fall along a spectrum from normally developing to autism spectrum disorder, with a person displaying increased numbers of autism-related characteristics (i.e., social and communicative impairments, etc.) the further he or she falls toward the autism spectrum disorder end of the continuum. Prior research has often found significant gender differences in autistic characteristic presence, with typically developing males tending to display more autistic characteristics than typically developing females. In this study, this comparative autistic characteristic research was extended to younger ages by investigating potential gender differences in two parent-reported measures of developmental areas closely related to the autistic continuum (social responsiveness, sociability, impulsivity, and inhibitory control) for non-diagnosed 30-month-olds. No significant gender differences were found in any of these areas, but differences in several areas were trending toward significance. These results have important implications for academic inquiry and research in the field, as well as for intervening in issues related to the social development of young male children.

Keywords: autistic continuum, gender differences, toddlers

Exploring Gender Differences in Autism-Spectrum-Related Developmental Areas in 30-Month-Olds

Autism spectrum disorder (ASD) is a range of developmental conditions typically defined by social and communicative impairments and highly repetitive, focused behaviors (Granader et al., 2014). Individuals diagnosed with autism spectrum disorder also often display severe sensory issues (McCormick, Hepburn, Young, & Rogers, 2016) as well as reduced cognitive flexibility and organizational abilities (Granader et al., 2014).

An interesting aspect of this disorder is its distinctly male bias in diagnosis and prevalence. The ratio of male cases of ASD to female cases of ASD has been reported in the literature to be anywhere from 2:1 to 6:1 depending on the particular data analyzed (with an average of about 4.2:1), indicating that this condition is prevalent at much higher rates in male children and adults than in females (Becker, 2012; Centers for Disease Control and Prevention, 2016). Though a true explanation for this distinct gender difference is unknown, a variety of theories exist – for example, some posit that certain genetic and/or biochemical mechanisms in males lead to ASD's male bias (Baron-Cohen, 2002; Pfaff, Rapin, & Goldman, 2011). This thesis overall aims to expand on this gender bias concept by shedding further light on autism-spectrum-related developmental differences between males and females. Notably, little recent research has been conducted on potential gender differences related to the autism spectrum in very young children (e.g., toddlers – used throughout this thesis to mean younger than 3 years old), which is what the proposed study will attempt to address.

The Autistic Continuum and the "Autism-Spectrum Quotient"

Related to the concept of autism spectrum disorder is the idea of an "autistic continuum," a concept that contains a similar gender divide of its own and provides a focus of study for this

thesis. The autistic continuum is the concept that autism spectrum disorder and its associated characteristics are less of a categorical, isolated disorder and more of a continuum; under this idea, all people fall on a continuous range of sorts from "normality" (no or very few autistic-like deficits) to autism spectrum disorder, with a person displaying more and more autism-associated traits (e.g., social and communicative difficulties, sensory issues, etc.) the farther he or she falls toward the "autism" side (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001).

In 2001, Dr. Baron-Cohen and colleagues devised and reported a method for identifying where different individuals fall on the autistic continuum – the Autism-Spectrum Quotient, a 50question instrument designed to measure where adults of normal intelligence lay along the continuum from normality to severe autism spectrum disorder (Baron-Cohen et al., 2001). Individuals completing the form indicate their level of agreement with various descriptions of their personal behaviors and attributes; each question is designed to assess their possession (or lack thereof) of particular autism-spectrum-associated traits. Subjects' responses are then scored and analyzed, and a value known as the Autism-Spectrum Quotient is calculated for each subject. Higher Autism-Spectrum Quotient values indicate the presence of more autistic traits - i.e., the person is further along the continuum towards autism spectrum disorder (Baron-Cohen et al., 2001). A variety of studies have suggested that the Autism-Spectrum Quotient is fairly reliable and valid in detecting and measuring general autistic traits (Murray, Booth, McKenzie, & Kuenssberg, 2016; Stewart, Allison, Baron-Cohen, & Watson, 2015), lending credibility to this instrument and its findings.

Gender Differences in the Autism-Spectrum Quotient/Autistic Continuum Adult Gender Differences Research for the ASQ

A notable finding of the original Autism-Spectrum Quotient study was that typically developing (used throughout this thesis to mean "possessed no autism-related diagnoses") adult males tended to have significantly higher Autism-Spectrum Quotients than did typically developing adult females (similar to the male bias in clinically diagnosed autism spectrum disorder, as discussed earlier). In this study, 3.9% of typically developing males also displayed more extreme values of the Autism-Spectrum Quotient, while no typically developing females did (Baron-Cohen et al., 2001). This finding was drawn from a large sample of typically developing study subjects – 174 adults that did not possess any autism-related diagnoses, consisting of a fairly well-balanced 76 males and 98 females - that covered a broad age range in each gender (18 to 60 years old overall). This provides evidence for the observed Autism-Spectrum Quotient gender difference likely being valid and potentially relevant over a broad spectrum of life stages/ages. This striking finding overall suggests that even non-diagnosed, typically developing individuals may display a gender bias in autistic characteristics similar to that of clinically diagnosed autism spectrum disorder (Baron-Cohen et al., 2001).

More recent studies have confirmed that typically developing adult males often display higher Autism-Spectrum Quotients than typically developing adult females. A study conducted by Zhang and colleagues to evaluate the suitability of the Autism-Spectrum Quotient measure for mainland Chinese populations and to investigate gender differences in autistic characteristics found that Chinese adult males had significantly higher Autism-Spectrum Quotients on average than did Chinese adult females who were well-matched to them in age. This finding notably suggests that age effects of any kind were likely not responsible for the observed Autism-Spectrum Quotient difference (since age was held very similar between male and female study participants) and that gender was thus likely the driving factor (Zhang et al., 2016). Zhang and colleagues (2016) conducted their study with primarily middle-aged Chinese individuals, providing age and geographic/ethnic diversity in supporting the results of Baron-Cohen et al. (2001). Zhang and colleagues' results further suggest that typically developing adult males may tend to display more autistic traits than typically developing adult females.

A 2004 study by Bishop and colleagues assessing whether parents of autistic children would display higher Autism-Spectrum Quotient scores than parents of typically developing children provides further evidence to support Baron-Cohen and colleagues (2001) [Bishop et al., 2004]. Bishop and colleagues found that fathers of even non-diagnosed children tended to score significantly higher than mothers of non-diagnosed children on the Autism-Spectrum Quotient measure, a finding very similar to that of Zhang and colleagues (2016) and Baron-Cohen and colleagues (2001). This study affords further evidence that typical adult males may possess more autistic-like traits than typical adult females do on average.

A 2010 study by Stewart and Austin investigating the structure and validity of different parts of the Autism-Spectrum Quotient measure in a sample of Scottish university students additionally supports the results of the previously mentioned studies. As part of their study, Stewart and Austin (2010) found that male university students had significantly higher Autism-Spectrum Quotient scores on average than did female university students on the social skill- and communication-related domains of the measure (as expected). These results generally corroborate those of Zhang and colleagues (2016), Baron-Cohen and colleagues (2001), and Bishop and colleagues (2004), adding more geographic and age diversity to the overall findings.

Child Gender Differences Research for the ASQ

Some limited research has been conducted on gender differences related to the Autism-Spectrum Quotient in relatively young, typically developing children (4 years old and older) as well; this research has generally further confirmed the male bias in autistic characteristics demonstrated by adult studies. For example, Auyeung, Baron-Cohen, Wheelwright, and Allison (2008) developed a modified, parent-report children's version of the Autism-Spectrum Ouotient questionnaire, designed to measure autistic trait prevalence in children aged 4 to 11 years old. In this children's version of the Autism-Spectrum Quotient measure, the questions on the original measure were altered to make them more age-appropriate for autistic-like attributes of younger children. Auyeung et al. (2008) conducted a study to assess the score distribution, reliability, and validity of the children's Autism-Spectrum Quotient measure among a large sample of 4-9 year olds in the United Kingdom. Notably, this study found significant and expected gender differences in parent-reported responses on the children's version of the Autism-Spectrum Quotient measure. In the study's large sample (1225 children possessing no autism-related diagnoses, consisting of 607 males and 618 females), male children possessed significantly higher children's Autism-Spectrum Quotients on average than did female children. This striking finding echoes the results of Baron-Cohen et al. (2001) and the other previously described Autism-Spectrum Quotient studies and provides evidence for the gender disparity in autistic characteristics being present even in younger children and observable as young as four years old.

A 2010 study by Wakabayashi and colleagues (2010) exploring whether the findings of the children's Autism-Spectrum Quotient measure would be replicated in a sample of Japanese children supports the results of Auyeung et al. (2008). As part of their study, Wakabayashi et al. (2010) found a large sample of Japanese children (372 6-16 year olds possessing no autismrelated diagnoses, consisting of 188 males and 184 females) to display a distinctly male bias in autistic trait prevalence; male children had significantly higher children's-version Autism-Spectrum Quotients on average than did female children. This finding supports the results of Auyeung et al.'s study on the children's version of the Autism-Spectrum Quotient (2008) and provides further evidence for the male gender bias in autistic characteristics even at younger ages.

Measuring Toddlers' Autistic Characteristics and Related Gender Differences

Notably, while the aforementioned Autism-Spectrum Quotient studies cover a rather wide age range (about early childhood to later adulthood) in support of the notion that typically developing males tend to display more autistic traits/higher levels of autistic symptomatology than typically developing females, neither they nor much other recent literature cover potential male/female autistic trait differences in typically developing males and females younger than about four years of age. This is likely at least partially because the parent-reported children's version of the Autism-Spectrum Quotient measure is intended for assessing children ages 4 and older (Auyeung et al., 2008; Ota, Stewart, Petrou, and Dickie, 2015). As such, this children's version would not be appropriate for assessing autistic trait gender differences in toddlers. However, several widely used measures of childhood behavior and temperament that *are* appropriate for toddlers do exist that can assess various developmental constructs closely related to the autistic continuum (which could thus allow for gender comparisons in autistic traits); these developmental constructs include social responsiveness, sociability, impulsivity, and inhibitory control.

Social Responsiveness

"Social responsiveness" is generally defined as the ability to engage in effective social interaction with other individuals, understand social cues, and behave in reasonable ways in social settings (Constantino & Gruber, 2012). This concept is directly related to autistic continuum symptomatology; individuals deficient in social behavior/social interaction typically

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receive higher Autism-Spectrum Quotient scores – that is, they trend further along the "autism spectrum disorder" side of the autism spectrum continuum (Baron-Cohen et al., 2001).

Some recent research on gender differences in social responsiveness has been conducted in both typically developing older individuals and relatively young, typically developing children. For example, a 2013 study by Hus and colleagues on factors affecting scores on a widely used measure of social responsiveness and autistic symptomatology (the Social Responsiveness Scale; Constantino & Gruber, 2012) revealed that adolescent males tended to display significantly more social interaction/behavior deficiencies than adolescent females (Hus, Bishop, Gotham, Huerta, & Lord, 2013). This gender difference is generally as expected - i.e., males displaying more "autistic traits" - and very similar to that seen in studies using the Autism-Spectrum Quotient (ex. Stewart & Martin, 2010). Similarly, a 2013 study by Salley and colleagues analyzing relationships between temperament and social responsiveness in young children found evidence for 4-year-old males being much more likely to display deficits in social interaction and communication than 4-year-old females (Salley, Miller, & Bell, 2013); this gender difference is also as expected given the male bias in autistic trait prevalence. The general findings of these recent studies tend to agree with older research on gender differences in social responsiveness, which has demonstrated that both adolescent males (ex. Margalit & Eysenck, 1990) and males attending kindergarten (ex. Swartz & Walker, 1984) tend to display lower social responsiveness/worsened social behavior than females in both of these age categories.

However, as with the Autism-Spectrum Quotient measure itself, little recent research on social responsiveness that focuses on gender differences has been conducted with typically developing toddlers ("toddlers" is used throughout this thesis to mean younger than 3 years old). A widely used parent-reported measure of social responsiveness that is appropriate for toddleraged children, the Social Responsiveness Scale, Second Edition, can be used to conduct such research and explore potential gender differences (Constantino & Gruber, 2012).

Previous research with the Social Responsiveness Scale. It should be noted that the Social Responsiveness Scale - a Likert-scale-based measure of a child's social behavior and related autistic-like symptomatology – has been utilized to explore a variety of questions in previous recent research on children; however, little of this research has concentrated principally on investigating gender differences in detail. Ko, Kim, Kim, Song, and Cheon (2016) utilized the Social Responsiveness Scale primarily to explore epilepsy's effect on autistic symptomatology in children diagnosed with autism spectrum disorder, while Jussila et al. (2015) conducted a study to evaluate the measure's usefulness in screening autism-related traits in a Finnish population of male children (both ASD-diagnosed and undiagnosed males were studied). Cholemkery, Mojica, Rohrmann, Gensthaler, and Freitag (2014) explored whether the Social Responsiveness Scale could reliably differentiate autism spectrum disorder and social anxiety conditions in both young children and adolescents, while Hus et al. (2013) investigated factors that could affect children's and adolescents' scores on this measure (e.g., demographics, cognitive skills, etc.). Though many studies like these have been conducted using the Social Responsiveness Scale, few have focused exclusively on exploring gender differences in the measure. Additionally, many of the studies using the Social Responsiveness Scale that have included gender analyses have had conflicting findings – some found no gender differences in Social Responsiveness Scale scores (Ko et al., 2016), while others found males and females to display significantly different Social Responsiveness Scale scores (Hus et al., 2013). As such, additional research with the Social Responsiveness Scale focusing on exploring potential gender differences would be interesting and prudent to conduct.

Sociability

Another developmental construct linked to the autism spectrum is "sociability," which is generally defined as seeking out social interactions and enjoying these social experiences (Putnam, Gartstein, & Rothbart, 2006). Though quite similar to the aforementioned concept of social responsiveness, "sociability" is typically drawn less from autism-spectrum-related literature and more from studies of temperament in typically developing children (Constantino & Gruber, 2012; Putnam et al., 2006). Sociability is still related to the concept of an autistic continuum, though; individuals who do not enjoy or actively look for social experiences typically register higher Autism-Spectrum Quotients – that is, they trend away from "normality" on the autism spectrum continuum (Baron-Cohen et al., 2001).

As with social responsiveness, some fairly recent research on gender differences in sociability has been conducted in both typically developing adults and relatively young, typically developing children. For example, a 2015 study by Pisula and colleagues on links between autistic-related characteristics and temperament found that males attending college tended to display significantly lower sociability than females attending college and also scored higher on autistic trait presence, as expected (Pisula, Kawa, Danielewicz, & Pisula, 2015). Similarly, a 2003 study by Russell, Hart, Robinson, and Olsen (2003) analyzing different contributors to American and Australian children's sociability and aggressiveness with peers found 4-6-year-old American and Australian males to display significantly lower sociability than American and Australian the display significantly lower sociability than the additional additional additional additional and the additional additionadditional additional additional additional additional additio

college (ex. Czeschlik & Nürk, 1995) and adolescent males (ex. Kaplan, 1991) tend to display lower sociability than females in both of these age categories.

However, little recent research on sociability that focuses on gender differences has been conducted with toddlers, as with the Autism-Spectrum Quotient measure itself. A sociability-measuring subscale of a widely used parent-reported measure of behavior and temperament in toddlers, the Early Childhood Behavior Questionnaire-Short Form, can be used to conduct such research and explore potential gender differences (Putnam et al., 2006; Putnam, Gartstein, & Rothbart, 2010a).

Previous research with the ECBQ. It should be noted that – like the Social Responsiveness Scale - the Early Childhood Behavior Questionnaire (ECBQ; a Likert-scalebased measure of various aspects of temperament in typically developing children) has been utilized to explore a myriad of questions in previous research on children; however, little of this research has concentrated principally on investigating gender differences in particular aspects of temperament in detail. Slobodskya and Kozlova (2016) utilized the ECBQ primarily to explore early temperament's ability to predict later personality aspects in young children, while Simeonova et al. (2014) used the measure to explore relationships between temperament and behavior in toddlers of mothers diagnosed with bipolar disorder. Mink, Henning, and Aschersleben (2014) utilized the ECBQ to investigate the predictive relationship between the shyness aspect of 18-month-olds' temperaments and their Theory of Mind capabilities at 3 years old, while Stepień-Nycz et al. (2015) used the measure as part of a study exploring the relationships between different aspects of early emotion control and attention and later selfregulation capacities in young children. Though many studies like these have been conducted using the Early Childhood Behavior Questionnaire, few have focused exclusively on exploring

gender differences in the measure. Additionally, many of the studies using the ECBQ that *have* included gender analyses have had inconsistent findings – some found no significant gender differences in ECBQ subscale scores (Simeonova et al., 2014), while others found males and females to display different scores in certain subscales of the ECBQ (Mink et al., 2014). As such, additional research with the Early Childhood Behavior Questionnaire focusing on exploring potential gender differences would be interesting and prudent to conduct.

Impulsivity

Another autistic-trait-relevant developmental construct is "impulsivity," which is often defined as a tendency to engage in one's dominant response very quickly, often without regard for correctness or others (Putnam et al., 2006). This concept is closely related to the idea of an autistic continuum; being overly impulsive without considering others or being able to control oneself tends to result in a higher Autism-Spectrum Quotient and reveal a trending toward the autism spectrum disorder side of the autism continuum (Baron-Cohen et al., 2001; Granader et al., 2014).

Similarly to both social responsiveness and sociability, some recent research on gender differences in impulsivity has been conducted in both typically developing older individuals and relatively young, typically developing children. For example, a 2014 study exploring relationships between different aspects of teenagers' personalities and temperaments found that adolescent boys tended to display significantly more impulsivity/impulsive behaviors than teenage girls (Piko & Pinczés, 2014). Similarly, a study by Pham (2016) exploring how various behavioral and attention-related developmental constructs contributed to reading achievement in elementary-school-aged children found evidence for 8-11 year old males displaying far higher average impulsivity and impulsive behaviors than 8-11 year old females. The general findings of these recent studies tend to agree with older research on gender differences in impulsivity, which has demonstrated that males attending college (ex. Miller & Burns, 1994) and males attending preschool (ex. Victor, Halverson, & Montague, 1985) tend to display higher impulsivity than females in both of these age categories.

Again, however, little recent research on impulsivity that focuses on gender differences has been conducted with toddlers. An impulsivity-measuring subscale of the aforementioned Early Childhood Behavior Questionnaire-Short Form can be used to conduct such research and explore potential gender differences, as this measure is appropriate for toddler-aged children (Putnam et al., 2006; Putnam et al., 2010a).

Inhibitory Control

An additional developmental construct linked to the autistic spectrum is "inhibitory control," which is generally defined as being able to reduce, modulate, and/or stop one's behavior when being told to do so (Putnam et al., 2006). Inhibitory control is closely related to the concept of an autistic continuum; displaying low inhibitory control tends to raise one's Autism-Spectrum Quotient (indicates the presence of more autistic traits), while a high degree of inhibitory control tends to indicate a position on the autism spectrum nearer to the "normality" end (Baron-Cohen et al., 2001; Granader et al., 2014).

Some recent research on inhibitory control differences between males and females has been conducted in both typically developing older subjects and relatively young, typically developing children. For example, a 2008 study assessing gender differences in men's and women's inhibitory control abilities found that women were more accomplished than men at demonstrating inhibitory control on a particular experimental response task – largely as expected based on previous findings of autistic trait differences between males and females (Yuan, He, Qinglin, Chen, & Li, 2008). Similarly, a 2013 study by Weiss, Heikamp, and Trommsdorff (2013) on gender differences in German schoolchildren's academic achievement found that German elementary-school-aged males tended to display worse behavioral regulation/inhibitory control abilities than German elementary-school-aged females, and a 2013 study by Gagne, Miller, and Goldsmith (2013) found male 3-year-olds to display lower inhibitory control than 3-year-old females; these gender differences were also as expected based on the observed male bias in autistic characteristics. The general findings of these recent studies tend to agree with older research on gender differences in inhibitory control, which has demonstrated that males attending college (ex. Friedman & Miller-Herringer, 1991) and males in early childhood (ex. Kochanska, Murray, & Coy, 1997) tend to display lower inhibitory control than typically developing females in both of these age categories.

However, as with social responsiveness, sociability, and impulsivity, little recent research on inhibitory control that focuses on gender differences has been conducted with typically developing toddlers. An inhibitory-control-measuring subscale of the aforementioned Early Childhood Behavior Questionnaire-Short Form can be used to conduct such research and explore potential gender differences, as this measure is appropriate for toddler-aged children (Putnam et al., 2006; Putnam et al., 2010a).

Description and Hypotheses of the Proposed Study

As the previously described constructs of social responsiveness, sociability, impulsivity, and inhibitory control can all be quite directly related to and contained within the autistic continuum (Baron-Cohen et al., 2001; Granader et al., 2014), it seems reasonable to explore gender differences in these constructs as autistic trait differences. The proposed study thus overall attempts to extend research on gender differences in autistic traits to much younger children by exploring potential gender differences in these autistic-continuum-related developmental constructs in typically developing 30-month-old toddlers. This will be done by analyzing existing parent-report data/scores on the Social Responsiveness Scale-2 (Constantino & Gruber, 2012) and several subscales of the ECBQ-Short Form (Putnam et al., 2006; Putnam et al., 2010a) for a sample of typically developing 30-month-olds. It is hypothesized that male and female 30-month-olds will display significant differences in these developmental areas and associated measures, such that males will possess more "autistic traits" (lower social responsiveness, lower sociability, higher impulsivity, decreased inhibitory control).

Method

Participants

This study involved secondary data analyses of existing data. The data records for this study were originally obtained from parents who had participated in another study at UNC-Chapel Hill, the "Attention and Regulatory Development in the First Three Years" study (Stephens, 2016). These parents were a subset of those who had been originally recruited from publicly available North Carolina birth records as part of UNC-Chapel Hill's second Early Development Project (a multidisciplinary, allied health-based project investigating methods of early screening and early intervention for autism spectrum disorder) ["Early Development Project," 2016; Stephens, 2016]. In this Early Development Project, parents completed the First Year Inventory questionnaire (Baranek, Watson, Crais, & Reznick, 2003; Reznick et al., 2007 – a measure designed to identify infants potentially at risk for autism spectrum disorder) when their child was 12 months of age. Those parents of children who did not meet the First Year Inventory's dual-domain risk criteria to be flagged as "at risk" for an eventual diagnosis of autism spectrum disorder who agreed to be contacted for follow-up research were eligible to

participate in an ongoing study of early childhood development (Stephens, 2016). It is important to note that this restriction in the ASD risk status of children potentially eligible for inclusion in this study could have created a biased/skewed sample for the current study, which will be discussed further in the Discussion section of this document.

Data for the current study represent subsets of parent-reported surveys (N = 343 for the Social Responsiveness Scale-2, including data for 168 male and 175 female typically developing toddlers; N = 318 for the Early Childhood Behavior Questionnaire-Short Form, including data for 156 male and 162 female typically developing toddlers) completed online by parents of toddlers within four weeks of their toddlers turning 30 months (2.5 years) of age. Two parents were excluded because their toddlers possessed ASD-related diagnoses at 30 months of age. Parents who completed the Social Responsiveness Scale-2 were 88.0% percent white, with about 97.3% possessing at least some tertiary (i.e., beyond high school) education and about 76.1% earning at least \$60,000 per year. Parents who completed the Early Childhood Behavior Questionnaire-Short Form were 88.4% white, with about 97.4% possessing at least some tertiary education and about 75.7% earning at least \$60,000 per year (see Table 1 for full demographics).

Measures/Materials

The Social Responsiveness Scale-2. The Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012) was utilized to assess social responsiveness and potential deficiencies in social behavior in the participant parents' 30-month-olds. The SRS-2 is a 65question, Likert-scale-based questionnaire that was designed to measure symptomatology related to autism spectrum disorder, focusing on assessing an individual's ability to understand and engage in normal social interaction; this questionnaire has been shown to be quite reliable and valid in assessing this social symptomatology (Constantino & Gruber, 2012). Parents answer questions about their child's social behaviors and activities, each on a scale ranging from 1 (Not True) to 4 (Almost Always True), with responses then summed to calculate a total score. This sum typically ranges from 0 to 134, with higher scores indicating more deficient social interaction/social behaviors. SRS-2 scores for each toddler were calculated and analyzed for the current study in order to explore the range of scores across the community-based experimental samples and compare gender differences (Constantino & Gruber, 2012).

The Early Childhood Behavior Questionnaire-SF. The Early Childhood Behavior Ouestionnaire, Short Form (ECBO-SF; Putnam et al., 2010b) was utilized in the present study to assess various autism-spectrum-related aspects of temperament in the participant parents' 30month-olds. Specifically, the sociability, impulsivity, and inhibitory control subscales of the ECBQ-SF were analyzed, as these were expected to be most closely related to ASD symptomatology. The ECBQ-SF is a 107-question, Likert-scale-based questionnaire that measures various aspects of a toddler's temperament and behavior, several of which are directly related to the concept of an Autism-Spectrum Quotient/the autistic continuum (sociability, impulsivity, and inhibitory control – see the introduction of this paper for more details). Parents answer questions about how often they observed their child engaging in various behaviors in the previous two weeks, each on a scale ranging from 1 (Never) to 7 (Always); an option for "Does Not Apply" (NA) is available as well. These questions probe different dimensions of children's temperamental and behavioral characteristics with good reliability and validity (Putnam et al., 2006). Parents' numerical responses to the questions are then grouped into different subscales, and responses to all of the questions in each subscale are then averaged to create a score for that particular subscale. A higher score on a particular subscale indicates more of that temperament aspect being observed in that child (higher sociability, higher impulsivity, etc.).

In the present study, the sociability (seeking out and enjoying social interactions), impulsivity (engaging in one's dominant/desired response quickly and with little regard for correctness or others), and inhibitory control (being able to refrain from doing something when asked to do so) subscales (Putnam et al., 2010b) of the ECBQ-SF were analyzed in order to compare gender differences; see Appendix A for a list of the questions in each of these three subscales.

Procedure

Each participant parent had been emailed a link to complete a battery of developmentalconstruct-related surveys within four weeks of his or her toddler turning 30 months old as part of a previous study (Stephens, 2016); that battery of surveys included the SRS-2 and ECBQ-SF, thus providing the data for this secondary data analysis. In the present study, SRS-2 summed scores and ECBQ-SF sociability, impulsivity, and inhibitory control subscale scores were calculated for each toddler's survey data and compared between genders. Statistical testing was performed using IBM SPSS software (version 23.0; "IBM SPSS Statistics," 2014) to assess potential gender differences in autistic traits.

Results

Four independent-samples *t* tests were conducted in order to assess whether there were statistically significant differences in parent-reported: 1) social responsiveness/social behaviors, 2) sociability, 3) impulsivity, and 4) inhibitory control between the participant parents' male and female 30-month-olds (i.e., if there were significant differences in Social Responsiveness Scale-2 scores and Early Childhood Behavior Questionnaire-Short Form sociability, impulsivity, and inhibitory control subscale scores between males and females). There was no significant difference in Social Responsiveness Scale-2 scores between males (M = 51.85; SD = 8.22) and

females (M = 51.33; SD = 7.12), t(341) = 0.62, p > 0.05; see Figure 1. There was no significant difference in Early Childhood Behavior Questionnaire-Short Form sociability subscale scores between males (M = 5.94; SD = 0.83) and females (M = 5.78; SD = 0.88), t(316) = 1.65, p > 0.05; see Figure 2. However, the *p*-value for this *t* test was p = 0.10, which is slightly trending toward statistical significance. There was no significant difference in Early Childhood Behavior Questionnaire-Short Form impulsivity subscale scores between males (M = 4.46; SD = 1.07) and females (M = 4.22; SD = 1.18), t(316) = 1.93, p > 0.05; see Figure 3. However, the *p*-value for this *t* test was p = 0.055, which is also trending toward statistical significance. There was no significant difference. There was no significant difference in Early Childhood Behavior Questionnaire-Short Form impulsivity subscale scores between males (M = 4.46; SD = 1.07) and females (M = 4.22; SD = 1.18), t(316) = 1.93, p > 0.05; see Figure 3. However, the *p*-value for this *t* test was p = 0.055, which is also trending toward statistical significance. There was no significant difference in Early Childhood Behavior Questionnaire-Short Form inhibitory control subscale scores between males (M = 4.15; SD = 0.43) and females (M = 4.20; SD = 0.42), t(316) = -1.03, p > 0.05; see Figure 4.

Discussion

The present study involved the investigation of potential gender differences among 30month-old toddlers in various areas of development previously linked to autistic symptomatology or the autistic continuum (i.e., the concept that individuals fall along a symptomatic range from "normality" to severe autism spectrum disorder). There was no significant observed gender difference in social responsiveness between male and female 30month-olds (and little variance difference), thus failing to support my first hypothesis. This result is not in line with previous research from Salley and colleagues (2013) and Swartz and Walker (1984), who observed significant differences in social responsiveness between 4-year-old males and females and kindergarten-attending males and females, respectively (with males displaying lower social responsiveness in both studies). Importantly, Salley and colleagues (2013) used a parent-reported measure of children's social responsiveness (the Social Responsiveness Scale) that is quite similar to the measure used in the present study to assess social responsiveness, providing some evidence to suggest that the current result is likely not simply due to the mode of assessing social responsiveness. Instead, it may be the case that gender differences in social responsiveness are not observable or present at 30 months of age, unlike in slightly older children. This idea should be tested and ideally replicated by future research.

These findings regarding gender differences in social responsiveness also generally agree with prior research that suggests that various gender differences tend to emerge and develop during particular life stages (i.e., are not observable during all parts of the life course and may emerge and/or manifest only at particular times). For example, Palejwala and Fine (2015) found that male and female children tended to display significant differences in patterns of development of various aspects of cognitive and visual processing between 2 and 7 years old; these differences manifested and developed specifically during this life stage (Palejwala & Fine, 2015). Similarly, my finding may suggest that gender differences in social responsiveness may only develop and/or manifest sometime after 30 months of age.

Analyses of differences in sociability revealed a marginal, though non-significant, effect of gender. Additionally, this trend pointed toward male 30-month-olds receiving higher sociability scores than did their female counterparts (but little variance difference). These results failed to support my second hypothesis, and the trending observed difference was contrary to expectations that males would receive poorer sociability scores than females. This result differs from those of Russell and colleagues (2003), who found significant differences in sociability between 4-6 year-old males and females in both American and Australian populations (with males displaying generally lower sociability). It is important to note that Russell and colleagues (2003) utilized a teacher-report measure to assess sociability in 4-6 year-old children, which is rather different from the parent-report measure used in the present study to assess sociability (teachers might rate children's characteristics differently than parents might, as teachers tend to observe children in a different context and might have different expectations for children). Despite this methodology difference, Russell et al.'s (2003) gender difference results agree well with other research in the field (which has utilized a variety of methods – see Introduction), suggesting a difference between my sociability findings and those of Russell et al. that is not driven simply by methodology (since previous sociability gender difference findings have been similar across different methodologies). Similarly to my social responsiveness findings, my results may suggest that the hypothesized gender differences in sociability might not be present or observable at 30 months of age. This finding should be tested and ideally replicated in future research.

Although gender differences in impulsivity were not statistically significant, thus failing to support my third hypothesis, there was a strong trend toward significance, such that males were reported as having marginally higher levels of impulsivity (but little variance difference). This trend does somewhat support the findings of Victor and colleagues (1985), who found significant differences in impulsivity between preschool-attending males and females (with males displaying higher impulsivity); however, my results still produced no significant gender difference. Victor and colleagues (1985) did use a teacher-report measure of children's impulsivity (the Preschool Rating Scale for Teachers) that is notably different from the parent-report measure utilized in the present study to assess impulsivity; despite this methodology difference, Victor et al.'s (1985) gender difference results agree well with other research in the field (which has utilized a myriad of methods – see Introduction), suggesting a difference between my impulsivity findings and those of Victor et al. that is not driven simply by mode of

assessing impulsivity (since previous impulsivity gender difference findings have been similar across methodologies). My results thus overall suggest that the expected gender differences in impulsivity might not be present at 30 months of age, but future research is certainly needed due to the strongly trending potential/marginal difference.

Before further analysis of results, it is important to note that the aforementioned marginal (but not significant) differences in parent-reported sociability and impulsivity between 30month-old males and females were quite strongly trending toward significance, hinting at the possible presence of gender differences that this study perhaps simply did not identify. As such, it might be prudent to repeat this study with several different populations of individuals (and perhaps larger sample sizes) to see if such potential sociability and impulsivity gender differences might actually be observable (and what the direction of such potential differences might be).

Finally, there was no significant observed gender difference in parent-reported inhibitory control between male and female 30-month-olds (and little variance difference), thus failing to support my fourth (and final) hypothesis. This result differs from those of Gagne and colleagues (2013) and Kochanska and colleagues (1977), who found significant differences in inhibitory control between 3-year-old males and females and males and females in early childhood, respectively (with males displaying lower inhibitory control in both studies). Importantly, Gagne and colleagues (2013) used a parent-report measure of children's inhibitory control (the Children's Behavior Questionnaire) that is quite similar in format to the measure used in the present study and agreed well with Kochanska et al.'s (1977) observational method of assessing inhibitory control; this provides some evidence to suggest that my inhibitory control result is likely not simply due to a different method of assessing inhibitory control. Instead, it may be the

case that gender differences in inhibitory control are not observable or present at 30 months of age. This idea should be tested and ideally replicated by future research.

Overall, this study did not find statistically significant "autistic trait" gender differences at 30 months of age in several prominent areas of development (social responsiveness, sociability, impulsivity, and inhibitory control). These results break from related previous research that has suggested significant male-biased gender differences in these developmental areas among relatively young children (and adults - see Introduction); as such, future studies are needed to replicate these findings in order to determine whether the lack of gender differences at 30 months of age is consistent across studies. These results also might have important implications for engaging with young male children as they develop. A growing body of research has suggested that young, typically developing males might need "extra help" or more adult intervention than females in a variety of developmental domains - for example, dealing with negative emotions in an effective manner (Engle & McElwain, 2011) and developing healthy cognitive and social skills in varying classroom settings (Moller, Forbes-Jones, Hightower, & Friedman, 2008). The results of the present study might suggest that any potential efforts to address typically developing male children's generally higher display of autistic-related traits might focus on intervening after 30 months of age (since no significant trait differences were found in any of the analyzed developmental areas for 30-month-old toddlers). Such a strategy might result in more effective and targeted interventional efforts for typically developing male children. Of course, it would be prudent to compare outcomes of such a modified strategy to outcomes from the prevailing wisdom that earlier intervention is better.

It is important to be cautious about interpreting and/or generalizing the results of this study too broadly, however. As mentioned earlier, the slight (non-significant) observed gender

differences in sociability and impulsivity were trending toward significance, indicating that these domains might actually display 30-month-old male-female disparities and would thus benefit from further research. Additionally, the measures used to assess various developmental domains in this study were parent-reported, which could lead to concerns about validity based on the number of established biases related to parent reports of child behaviors (e.g., social desirability bias, among others). Therefore, it would be prudent to conduct a similar study using laboratory-based methods of assessing social responsiveness, sociability, impulsivity, and inhibitory control in order to control for such biases.

In addition, the parents who completed the present study's measures for their children were all mothers, which could have introduced an additional source of bias. There is a wealth of prior evidence suggesting that mothers often tend to have different developmental expectations and/or preferences for their sons and daughters and might possibly rate their characteristics differently based on these pre-defined biases (ex. Aznar & Tenenbaum, 2014). As mentioned earlier, laboratory-based methods of observing developmental domains might help eliminate these potential parental biases or unequal treatment of children. It should also be noted that the subjects of the present study were overwhelmingly white, well educated, and of relatively high socioeconomic status, which also limits generalizability quite significantly. The study should be repeated with diverse populations of individuals in order to see whether the results are consistent.

In addition, this study assumed that social responsiveness, sociability, impulsivity, and inhibitory control could be treated as "autistic traits" because they are so closely related to/contained within the idea of the autistic continuum (Baron-Cohen et al., 2001); future research might assess whether such an assumption is actually apt or whether alternate developmental domains might better reflect the autistic continuum when children are very young. Also, this

study involved only children who were not previously considered "high-risk" for autism spectrum disorder (see Method); this may have resulted in a biased sample that failed to include a large enough range of typically developing children. It would be prudent to repeat the study with some previously "high-risk" (but not later formally ASD-diagnosed, so still "typically developing" overall) children in order to see if the results of this study hold across this broader range of individuals.

Future studies might also explore additional/other developmental domains closely related to the autistic spectrum (e.g., behavioral fixation, sensory issues, etc.) in order to assess whether these areas might display consistent gender differences among typically developing children as young as those investigated in this study. Other potential research could also investigate possible intervention methods for male children's often-higher display of autistic traits at a variety of ages.

Overall, the results of this study augment existing research in the field by suggesting that 30-month-old children may not display gender differences in several autistic-related developmental domains. It is necessary to conduct further research into this topic in order to broaden our understanding of the autistic continuum overall, the timing of the onset of some of the key characteristics related to this continuum, and the extent of variability in young children's development.

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Table 1

	30-Month-Olds SRS-2 Sample, N =	30-Month-Olds ECBQ-SF Sample, N
	343	= 318
	N (%)	N (%)
Child	× /	· · ·
Gender		
Male	168 (49.0)	156 (49.1)
Female	175 (51.0)	162 (50.9)
Race		
Caucasian	302 (88.0)	281(88.4)
African	21 (6.1)	18 (5.7)
American		
Asian	10 (2.9)	9 (2.8)
Other	10 (2.9)	10 (3.1)
Mother		
Education		7(2,2)
Completed	7 (2.0)	/ (2.2)
High School	25 (10.2)	22 (10 1)
Some College*	35 (10.2)	32 (10.1)
4-year College Graduate	139 (40.5)	129 (40.8)
Post-Graduate	160 (46.6)	148 (46.5)
Household		
Income per		
Year		
Less than	17 (5.0)	15 (4.7)
\$35,000		
\$35,000-	62 (18.1)	59 (18.6)
\$60,000		
\$60,000-	84 (24.5)	77 (24.2)
\$90,000		
\$90,000-	109 (31.8)	100 (31.4)
\$150,000		
Greater than	68 (19.8)	64 (20.1)
\$150,000		

Demographic Information for SRS-2 and ECBQ-SF Study Participants

*Vocational or trade degree after high school, associate or 2-year degree, or some courses toward 4-year college degree



Figure 1. Mean Social Responsiveness Scale-2 scores for participant parents' 30-month-old toddlers, serving as a measure of social responsiveness. Error bars represent standard errors.



Figure 2. Mean Early Childhood Behavior Questionnaire-Short Form sociability subscale scores for participant parents' 30-month-old toddlers, serving as a measure of sociability. Error bars represent standard errors.



Figure 3. Mean Early Childhood Behavior Questionnaire-Short Form impulsivity subscale scores for participant parents' 30-month-old toddlers, serving as a measure of impulsivity. Error bars represent standard errors.



Figure 4. Mean Early Childhood Behavior Questionnaire-Short Form inhibitory control subscale scores for participant parents' 30-month-old toddlers, serving as a measure of inhibitory control. Error bars represent standard errors.

Appendix A

Subscales on the Early Childhood Behavior Questionnaire-Short Form Used in the Present Study

The following sets of questions constitute the three ECBQ-SF subscales of interest that were analyzed in the present study. The three subscales (sociability, impulsivity, and inhibitory control) were chosen because they measure developmental constructs/temperament aspects closely related to/contained within the autism spectrum, allowing for comparison of autistic traits between male and female 30-month-old study participants. All questions were answered on Likert scales ranging from 1 (Never) to 7 (Always), with an option for "Does Not Apply" (NA) available as well.

It should be noted that an "R" beside a question number indicates that the particular question needed to be "reverse-scored" – i.e., the score on the question needed to be subtracted from 8 (since there were 8 Likert-scale choices for each question) before calculating an overall subscale score; this was done in order to make sure that all questions within a subscale were addressing the same construct in the same manner during data analysis (Putnam et al., 2006).

Sociability Subscale (4 Questions)

Construct Definition: seeking and taking pleasure in interactions with others.

When a familiar child came to your home, how often did your child

16. seek out the company of the child?

When visiting the home of a familiar child, how often did your child

54. engage in an activity with the child?

When a familiar adult, such as a relative or friend, visited your home, how often did your child

96. want to interact with the adult?

When around large gatherings of familiar adults or children, how often did your child

106. enjoy playing with a number of different people?

Impulsivity Subscale (4 Questions)

Construct Definition: speed of response initiation.

When offered a choice of activities, how often did your child

- 17.R stop and think before deciding?
- 18. decide what to do very quickly and go after it?

When encountering a new activity, how often did your child

- 52.R sit on the sidelines and observe before joining in?
- 53. get involved immediately?

Inhibitory Control Subscale (6 Questions)

Construct Definition: the capacity to stop, moderate, or refrain from a behavior under instruction.

When asked NOT to, how often did your child

19.R touch an attractive item (such as an ornament) anyway?

When told "no", how often did your child

63. stop the forbidden activity?

When asked to wait for a desirable item (such as ice cream), how often did your

child

- 88.R go after it anyway?
- 89. wait patiently?

When asked to do so, how often was your child able to

- 97. stop an ongoing activity?
- 98. be careful with something breakable?