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Early sensory over-responsivity in toddlers with autism spectrum disorders as a predictor of family impairment and parenting stress

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Abstract

Background—Sensory over-responsivity (SOR) affects many individuals with autism spectrum disorders (ASD), often leading to stressful encounters during daily routines.

Methods—This study describes the associations between early SOR symptoms and the longitudinal course of restrictions in family life activities and parenting stress across three time points in families raising a child with ASD (n = 174). Covariates were child diagnostic severity, emotional problems, and maternal affective symptoms. At time 1 mean chronological age was 28.5 months. Children were administered the Autism Diagnostic Observation Schedule (ADOS) and Mullen Scales of Early Learning (MSEL). Parents completed the Infant Toddler Sensory Profile (ITSP), Infant Toddler Social Emotional Assessment (ITSEA), Beck Anxiety Index (BAI), and the Center for Epidemiologic Studies Depression Inventory (CES-D) at time 1; and the Parenting Stress Index (PSI) and Family Life Impairment Scale (FLIS) at the three annual time points.

Results—Latent Growth Curve Models indicated that higher SOR scores on the ITSP at time 1 were associated with higher initial levels of family life impairment and parenting stress and with a smaller magnitude of change over time. These associations were independent of severity of ADOS social-communication symptoms, MSEL composite score, ITSEA externalizing and anxiety symptoms, and maternal affective symptoms as measured by the BAI and CES-D. On average FLIS and PSI did not change over time however there was significant individual variability. Concurrently, SOR at time 1 explained 39–45% of the variance in family stress and impairment variables.

Conclusions—An evaluation of SOR should be integrated into the assessment of toddlers with ASD considering their role in family life impairment and stress.

Keywords

ASD; toddlers; sensory over-responsivity; family impairment; parenting stress

Higher rates of sensory over-responsivity (SOR) are observed in individuals across autism spectrum disorders (ASD), and SOR symptoms appear to persist from early childhood throughout the lifespan (see Ben-Sasson et al., 2009). SOR is a form of sensory modulation

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disorder manifested in intense and prolonged negative responses towards commonplace sounds, sights, tastes, smells, movements and touch leading to negative emotionality, distractibility, heightened stress, and avoidance of such input (e.g., avoiding eating soft textured foods, distress from sound of home appliances) as well as aggressive and defiant behavior (Reynolds & Lane, 2008). Rates of SOR in children with ASD vary from 56% – 79% (e.g., Baranek et al., 2006; Tomchek & Dunn, 2007), with a previously documented rate of 56% (>1 standard deviation (SD) below norms) in the current full sample at the first assessment point when children were 18–33 months of age (Ben-Sasson et al., 2007).

SOR in children with ASD has been associated with compromised participation in activities of daily living (Kay, 2001) and social interactions (Hilton, Graver, & LaVesser, 2007) as well as internalizing problems (Pfeiffer, Kinnealey, Reed, & Herzberg, 2005). Consequently caregivers of children with comorbid ASD and SOR are dealing with children who have elevated irritability and who often respond with emotional and behavioral dysregulation. In a previous paper on the present sample, maternal stress was concurrently associated with the child's dysregulation problems, which included the following scales: sensory sensitivities, sleeping problems, eating problems and negative emotionality (Davis & Carter, 2008). In this study we sought to examine whether SOR in toddlers with ASD predicts the course of parenting stress and family life impairment above and beyond diagnostic severity and maternal affective symptoms using a standardized detailed measure of sensory behaviors. At time 1 the majority of children in this sample showed extreme under-responsivity and very few showed sensation seeking/craving symptoms (Ben-Sasson et al., 2007), which also can cause strain in family life. We focused on SOR rather than other types of sensory modulation symptoms (i.e., sensation seeking and sensory under-responsivity) as it (1) involves the most challenging behaviors such as tantrums and resistance during routine and non-routine family activities; and (2) has the least measurement overlap with ASD diagnostic symptoms in the current DSM criteria (American Psychiatric Association, 2000), particularly in regards to sensory under-responsivity. Previous research from this sample indicated stability in SOR over time based on the Infant Toddler Social Emotional Assessment's (ITSEA: Carter & Briggs-Gowan, 2006) 6-item Sensory Sensitivity scale (Green, Ben-Sasson, Soto, & Carter, 2011). Studying the course of family impairment and parenting stress in relation to SOR can elucidate factors that challenge families early on and over time, and may require early intervention. Investigating the impairing nature of SOR in children with ASD is timely given the proposal to include unusual sensory behaviors as a subdomain of stereotyped behaviors in the DSM-V. Prior to examining the role of early SOR symptoms on parenting stress and family impairment we first examined the course of both family impairment and parenting stress among parents raising young children with ASD. Several studies have addressed parenting stress but there has been limited attention to family impairment, or the extent to which a child's symptoms disrupt routine family activities. Parents of children with ASD experience greater levels of parenting stress, depression, and anxiety than parents raising children with other developmental disabilities (Olson & Hwang, 2001; Seltzer, Kraus, Orsmond, & Vestal, 2001; Weiss, 2002), suggesting that these stress levels are not merely associated with the challenges of raising a child with a disability. Evidence from one- (Herring, Taffe, Tonge, Sweeney, & Einfled, 2006; Lecavalier, Leone, & Wiltz, 2006) and two-year (Peters-Scheffer, Didden, & Korzilius, 2012) follow-ups indicate relative stability in parenting stress in families of individuals with ASD. Several attempts have been made to identify child factors that predict stress in parents of individuals with ASD. Among these identified factors in cross-sectional studies are: the severity of ASD symptoms (Benson & Dewey, 2008; Osborne & Reed, 2009) and in particular, social-communication abnormalities (Hastings & Johnson, 2001; Konstantareas, & Homatidis, 1989; Werner DeGrace, 2004); an uneven intellectual profile (Konstantareas, & Homatidis, 1989); and executive dysfunction (Epstein et al., 2008). Concurrent evidence from this sample at the initial assessment indicated that maternal parenting stress was

associated with the child's dysregulation and social relatedness but not with child cognitive and communication skills (Davis & Carter, 2008). Thus, when predicting changes in parenting stress and family impairment variables, we controlled for child diagnostic and behavioral features. Behavior problems in children with ASD have been consistently linked to lower parental well-being (Bromley et al., 2004; Hastings & Brown, 2002; Konstantareas, & Homatidis, 1989; Lecavalier et al., 2006). Specifically, parenting stress in families raising a child with ASD has been positively correlated with hyperactivity, stereotyped behaviors, self-injurious behaviors, and sensory over-sensitivity (Lecavalier et al., 2006), as well as hyper-irritability (Konstantareas, & Homatidis, 1989). In a comparison of toddlers with ASD and those with developmental delays, initial and follow-up child emotional and behavioral problems contributed significantly more to maternal stress, parental mental health problems, and perceived family dysfunction than type of diagnosis (Herring, Taffe, Tonge, Sweeney, & Einfled, 2006). In a longitudinal study of individuals with ASD and intellectual disability, emotional and behavioral problems accounted for 34% and behavioral inflexibility towards objects added an additional 13.6%, of the variance in maternal stress whereas developmental age and ASD severity were not associated with maternal stress (Peters-Scheffer et al., 2012). Some behavior problems in individuals with ASD are likely associated with sensory symptoms and reflect efforts to avoid or control sensory input. For example, engaging in maladaptive forms of repetitive behaviors such as head banging and biting can function as ways for controlling vestibular or tactile input. It is important to note that not all sensory symptoms result in problem behaviors, and that repetitive behaviors can occur in the absence of SOR.

In an epidemiological study of children without ASD, SOR was associated with concurrent family impairment independent of the contribution of DSM psychopathologies and socio-demographic risk (Carter, Ben-Sasson, & Briggs-Gowan, 2012). Among families raising a child with Asperger syndrome (5–12 years old), Epstein et al (2008) found that children's sensory symptoms were strongly associated with maternal parenting stress ($r = .56$). We were interested in examining the relation between early child SOR symptoms and the course of parenting stress and family impairment as a window into the impact of early emerging sensory symptoms on family climate.

In this study, SOR, parenting stress, and family life impairment were measured using parent-report tools. Decreased maternal well-being could influence the parent's perceptions of her child's behavior. Maternal depression and anxiety have been associated with greater discrepancies in reporting child psychopathology symptoms compared to other informants (Briggs-Gowan, Carter, & Schwab-Stone, 1996). Including indicators of maternal anxiety and depression symptoms in these trajectory models was important to account for this response bias, which could also impact ratings of family impairment and parenting stress. In addition, evidence from the current sample at time 1 for relations between SOR, child anxiety and externalizing symptoms, cognitive level, social-communication symptoms, and maternal anxiety (Green et al., 2012) supported the inclusion of these parameters as covariates in the current research. This study sought to examine whether early SOR in children with ASD is associated with initial and later rates of change in family life impairment and maternal parenting stress. To better interpret these associations, families of children with and without clinically significant levels of SOR were compared on family impairment, parenting stress and child and parent factors.

Methods

Participants

The sample includes 174 toddlers with ASD and their mothers who participated in a longitudinal study examining trajectories of child development and parental adjustment

among families of children newly-diagnosed with an ASD. Toddlers had a mean chronological age of 28.5 months ($SD= 3.9$, range= 18–33 months of age) at time 1, 40.97 months ($SD= 4.23$) at time 2, and 53.17 ($SD= 4.57$) at time 3. Their mean Early Learning Composite score (ELCS) was 66.5 ($SD= 16.4$, range = 49–126) based on the Mullen Scales of Early Learning (MSEL; Mullen, 1995). Approximately three fourths of the sample (78%, $n= 136$) were boys and 80% ($n= 139$) of toddlers were identified by their mothers as Non-Hispanic/Latino White. At time 1, 55 (33.13%) toddlers were classified in the SOR group based on having ITSP SOR scores that were at least 2SD below age norms versus 111 classified in the non-SOR group. Eight toddlers were missing ITSP scores at time 1; see Table 1.

Mothers of toddlers in this sample were primarily the biological parent (99%) with an average age of 36.17 years (range= 19–58; $SD= 5.03$) at the time of participation. Eighty-four percent of mothers self-identified as Non-Hispanic/Latino White. Most mothers reported middle to upper class household incomes (88%) and had at least two years of college (79%). The majority of mothers were married or cohabiting (91%); fewer mothers were separated/ divorced (4%), or single and had never been married (5%).

Inclusion criteria were: (1) child's chronological age between 18 to 33 months; and (2) a diagnosis of autistic disorder or a pervasive developmental disorder based upon meeting research criteria on the Autism Diagnostic Interview-Revised (ADI-R; Rutter, LeCouteur, & Lord, 2003) and the Autism Diagnostic Observational Schedule-Generic (ADOS-G; Lord, Rutter, DiLavore, & Risi, 2002), as well as based on the clinical impression of an experienced clinical psychologist. Children with a physical disability, known genetic disorder, or neurological disorder were excluded. Only one child per family was included in these analyses to meet the statistical assumption of independence of observations.

Procedures

Participants were recruited through early intervention providers; specialty autism services programs, pediatricians, and word of mouth. Following a telephone screening for eligibility, mothers were sent consent forms, and a booklet that included the Infant Toddler Sensory Profile (ITSP; Dunn, 2002), Infant-Toddler Social and Emotional Assessment (Carter & Briggs-Gowan, 2006), Parenting Stress Inventory (PSI; Abidin, 1995), Family Life Impairment Scale (FLIS; Briggs-Gowan, 1997), Center for Epidemiologic Studies - Depression Inventory (CES-D; Radloff, 1977), and Beck Anxiety Index (BAI; Beck, Epstein, Brown, & Steer, 1988). A child visit took place in a laboratory setting, was videotaped, and included the ADOS-G (Lord et al., 2002) and MSEL (Mullen, 1995). A caregiver visit took place either at the child's home or at the research center and included the ADI-R (Rutter et al., 2003). Families were followed annually for two years after baseline. At each time, mothers completed the questionnaire booklet.

Measures

Child Measures—*Infant/Toddler Sensory Profile (ITSP; Dunn, 2002)*. The ITSP (7–36 months) is a 48-item caregiver questionnaire which measures sensory processing behaviors in daily experiences. Parents rate the frequency of each behavior from 1 'almost always' to 5 'almost never'. Scores are grouped into four scores: *Low Registration, Sensation Seeking, Sensory Sensitivity and Sensation Avoiding*, and are interpreted relative to age norms. A *Low Threshold* score (referred to as SOR in this study) is computed as the sum of Sensitivity and Avoiding scores. This composite score was applied in this study to classify children as presenting with SOR or not based on a cutoff of 2SDs below norms. Lower scores indicate a higher frequency of over-responsivity. In the normative sample the reliability of the composite scores ranged from 0.69 to 0.85, and validity was good (Dunn,

2002). For this sample Cronbach's alpha for ITSP Sensitivity items was 0.79, and 0.77 for Avoidance items.

Autism Diagnostic Observation Schedule-Generic (ADOS-G; Lord et al., 2000). The ADOS-G is a semi-structured observation used to measure social and communicative functioning and repetitive behaviors in individuals suspected of having an ASD. Most toddlers in this study ($n = 161$) were administered Module 1 (preverbal or have single words), and 6 toddlers were administered Module 2 (phrase speech). A diagnostic algorithm, based upon DSM-IV and ICD-10 criteria, can be computed from the *Reciprocal Social Interaction* and *Communication* scores, resulting in a diagnosis of autism, autism spectrum, or neither (Lord et al., 2002). In this study, we used the ADOS-G to confirm diagnostic symptoms and the *Social and Communication* composite standardized score as an indicator of autism symptoms.

Mullen Scales of Early Learning (MSEL; Mullen, 1995). The MSEL provide a direct assessment of cognitive functioning. It yields five scales (Fine Motor, Gross Motor, Visual Reception, Expressive Language, and Receptive Language) and an *ELCS*, a standard score that aggregates all scales except the Gross Motor Scale.

Infant-Toddler Social and Emotional Assessment (ITSEA; Carter & Briggs-Gowan, 2006). The ITSEA is a 166-item parent-report questionnaire that assesses the social and emotional competencies and problem behaviors of children 1- to 3- years old. Parents rate the degree to which their child exhibited certain behaviors in the past month (0 – not true/rarely, 1 – somewhat true/sometimes, 2 – very true/often). The ITSEA is comprised of four domains (Competence, Externalizing and Internalizing problem behaviors, and Dysregulation), and can be broken down into 17 individual scales, including a General Anxiety scale. The ITSEA has acceptable reliability, with alphas for the four domains ranging from 0.85 to 0.90, and for the 17 scales from 0.52 to 0.82. The ITSEA's test-retest reliability is good to excellent over a 6 day period ($\alpha = 0.76\text{--}0.91$) (Carter & Briggs-Gowan, 2006). In this sample, internal consistency ranged from 0.77–0.86 for the four domains, and from 0.52–0.86, with 2 scales below 0.6, for the 17 scales.

Family Measures—Parenting Stress Index/Short Form (PSI/SF; Abidin, 1995). The PSI is a parent self-report measure designed to assess parenting stress focusing on the parent-child system. It included 36 items comprising four scales: Parental Distress, Parent-Child Dysfunctional Interaction, Difficult Child Characteristics, and Defensive Responding. Parents rated each item on a 5-point Likert type scale ranging from 1 (strongly agree) to 5 (strongly disagree). The PSI Total Score was derived and higher scores indicated higher levels of stress. The scales show high internal consistency, with alphas of 0.80–0.91 and test-retest reliability ranged from 0.68–0.85 for the four scales over a 6-month period. In this study, internal consistency alphas ranged from 0.78–0.89 at time 1, from 0.79–0.89 at time 2, and from 0.83–0.92 at time 3.

Family Life Impairment Scale (FLIS; Briggs-Gowan et al, 1997). The FLIS is a parent-report scale that assesses the extent to which a child's behavior, personality, or special needs limit participation in typical family activities (e.g., taking the child to visit family or running errands) or negatively affect the parent. It is comprised of nineteen items rated on a 3-point scale from "not true" to "very true", which yield a Global Impairment score. This scale has acceptable internal consistency (Cronbach $\alpha = 0.85$) and 10- to 45-day test-retest reliability ($n = 119$, $M = 26.4$, $SD = 8.14$, $ICC = 0.71$). Internal consistency for the subscales in this sample ranged from Cronbach's alphas of 0.61–0.83 at time 1, from 0.65 to 0.79 at time 2, and from 0.62–0.80 at time 3.

Center for Epidemiologic Studies Depression Inventory (CES-D; Radloff, 1977). The CES-D is a self-report measure of adult depression symptoms that includes 20 items rated on a 4-point Likert scale ranging from 0 (rarely or none of the time) to 3 (most or all of the time). Higher total scores in the CES-D indicate greater risk for depression. This measure has shown high internal consistency (coefficient alpha values between 0.84–0.90) and good test-retest reliability (ranging from 0.51–0.67) for 2- and 4-week intervals (Radloff, 1977). In the current sample, the internal consistency alpha ranged from 0.88–0.92.

Beck Anxiety Inventory (BAI; Beck et al., 1988). The BAI is a self-report measure of physiological and cognitive symptoms of anxiety. It consists of 21 items with answers given on a 4-point scale of 0 (not at all) to 3 (severely). The respondent is asked to rate the degree to which he or she has “been bothered by these feelings” (e.g., nervous; fear of losing control) in the past week. Internal consistency (alpha) is 0.92 and 1-week test-retest correlation is 0.75 (Beck et al., 1988). For the current sample, Cronbach’s alphas ranged from 0.86 to 0.91.

Data Analysis

Missing data analysis indicated that data was missing completely at random (Little’s MCAR test $\chi^2[87] = 108.98, p > .05$). For all of the time 1 predictor variables (including covariates) less than 5% of data were missing. For the outcome variables, more data were missing as fewer families participated over time. Missing data percentages for families with fewer than 2 data points for FLIS and PSI were 13.2% for each variable. Full Information Maximum Likelihood (FIML) was used to estimate missing data in all statistical modeling. Despite relatively high levels of missing data, these cases were included in the analyses as FIML has been proven to be a robust estimator in SEM models (Enders & Bandalos, 2001).

A structural equation approach employing latent growth curve modeling (LGCM) was used to determine the rate of change in FLIS and PSI across 3 time points. Two LGCM’s (one for FLIS and one for PSI) were computed to characterize the slope of each of the factors over time. SOR, as defined by continuous scores on the ITSP at time 1, was used as a time-invariant predictor variable, predicting to both the intercepts and slopes in FLIS and PSI models. Additionally, scores on the CES-D and BAI at time 1 were used to create the time-invariant latent variable termed maternal affective symptoms. Initial exploratory models also included time 1 child covariates that were thought to potentially contribute to the trajectories of family impairment and parenting stress. These variables were ITSEA Anxiety, ITSEA Externalizing, ADOS Social-Communication, and Mullen ELCS.

Follow-up analyses were conducted to examine the clinical significance of SOR in family life. A clinically-high SOR group (2 SD below the standardization sample’s mean) and a non-SOR group were compared on family impairment and parenting stress over-time, as well as on time 1 child and maternal variables that were entered into LGCM. The equality of the estimated parameters for SOR and non-SOR groups was tested by a Wald Test. All models were estimated using maximum likelihood methods with MPlus 5.0 software (Muthén, & Muthén, 2007).

Results

Latent Growth Curve Models

Determining if early SOR in children with ASD is associated with later parenting stress and family impairment above and beyond baseline diagnostic characteristics, child anxiety and externalizing symptoms, and maternal affective symptoms was the primary goal of these analyses. Results of the LGCMs demonstrated good fit to the data. The baseline (theoretical) FLIS model, with SOR and maternal affective symptoms as predictors, demonstrated good

fit, $\chi^2(8) = 18.155$, $p = .020$, CFI = .97, TLI = .943 RMSEA = .086. Similarly, the baseline (theoretical) PSI model, with SOR and maternal affective symptoms in the model as predictors, demonstrated good fit, $\chi^2(8) = 18.319$, $p = .019$, CFI = .975, TLI = .952, RMSEA = .087.

To report the most parsimonious FLIS and PSI models, covariates were individually added to the baseline models and subsequently trimmed if they did not significantly predict to outcome variables or did not significantly improve overall model fit. Child externalizing, child anxiety, and ADOS Social-Communication were trimmed from both final models. MSEL ELCS was retained only in the FLIS model as it significantly predicted to the FLIS slope.

The final FLIS model, with SOR included as a predictor variable and maternal affective symptoms and MSEL ELCS as covariates, with slope loadings restricted to 0, 1, 2, (a linear increase over time), demonstrated good fit, $\chi^2(10) = 19.391$, $p = .036$, CFI = .973, TLI = .945, RMSEA = .073 (see Figure 1). The final PSI model, with SOR included as a predictor variable and maternal affective symptoms as a covariate, with slope parameters restricted to 0, 1, 2, also demonstrated good fit, $\chi^2(8) = 18.319$, $p = .019$, CFI = .975, TLI = .952, RMSEA = .087 (see Figure 2). Although the RMSEA for both models suggested marginal fit, since the relative chi-squares and the CFIs indicated good fit and sample size was small, results support an adequate fitting model (Brown, 2006).

In these models, SOR significantly predicted the intercept for family impairment ($\beta = -0.43$, $p < 0.001$) and parenting stress ($\beta = 0.39$, $p < 0.05$). The prediction of SOR to the slope of parenting stress was significant ($\beta = 0.36$, $p < 0.01$) and approached significance to the slope of family impairment ($\beta = 0.326$, $p = 0.07$). Maternal affective symptoms predicted the intercept of family impairment ($\beta = 0.398$, $p < 0.01$) and parenting stress ($\beta = 0.57$, $p < 0.01$), but not change (i.e., slope) in these variables (FLIS: $\beta = 0.015$, $p > 0.05$; PSI: $\beta = 0.009$, $p > 0.05$). The MSEL ELCS predicted the slope of family impairment ($\beta = -0.339$, $p < 0.01$), but not the intercept. LGCMS demonstrated significant individual variability around the slope for both FLIS and PSI.

Clinical-Group Comparisons on Family Life Impairment and Parenting Stress

We were interested in elucidating the clinical significance of the association between SOR and family variables by comparing FLIS and PSI scores over time for families of children with versus without clinically significant SOR scores. In this sample, 55 children were identified at time 1 with elevated SOR based on having ITSP *Low Threshold* scores that were more than 2 SD below age norms. Wald Tests of Parameter Constraints showed that mothers in the SOR group, contrasted to mothers in the Non-SOR group, reported significantly higher levels of parenting stress, and overall family impairment at each time point (see Table 1). Moreover, mothers within each group (SOR vs. Non-SOR) did not show significant changes in scores from time 1 to Time 3, in family impairment (SOR: Wald's Test = 0.19, $df = 2$, $p = .909$; Non-SOR: Wald's Test = 2.36, $df = 2$, $p = .307$) or parenting stress scores (SOR: Wald's Test = 0.86, $df = 2$, $p = .651$; Non-SOR: Wald's Test = 3.24, $df = 2$, $p = .198$).

Group Comparisons of Child and Maternal Factors

The SOR group showed a distinct clinical profile compared to the Non-SOR group at baseline with significantly lower concurrent social-communication scores on the ADOS-G, and higher ITSEA externalizing and general anxiety symptoms. In addition, mothers of the SOR group reported higher anxiety symptoms on the BAI and marginally higher depressive symptoms as measured by the CES-D compared to the Non-SOR group (see Table 1).

Discussion

Above and beyond the challenge of raising a toddler with ASD, SOR appears to increase maternal stress and the degree to which family life routines are disrupted. Primary findings from this longitudinal study of toddlers with ASD showed that parents of toddlers with higher SOR symptoms were more likely to have higher levels of initial parenting stress and family life restrictions, which persisted over a two-year period. SOR's association with family life impairment and parenting stress surpassed child diagnostic, anxiety and externalizing symptoms, as well as maternal affective symptoms, which was considered a proxy for shared reporting bias. Findings also indicate that toddlers with ASD and SOR were more likely to have lower severity of social-communication symptoms and higher levels of anxiety and externalizing problems than those without SOR. These findings underscore the need to assess the practical and psychological impact that sensory symptoms have on children and families to design more effective early intervention plans. This is particularly important given findings indicating that parenting stress may reduce parents' effectiveness in applying early intervention techniques (Osborne, McHugh, Saunders, & Reed, 2008).

The tested models, with SOR being associated with concurrent family life impairment and parenting stress, explained 43–58% of the variance in these outcomes, respectively. It is plausible that previous reports of the contribution of object inflexibility and emotional/behavioral problems in children with ASD to parenting stress (e.g., Peters-Scheffer et al., 2012) are actually measuring consequences of SOR for some children. The magnitude of these effects are consistent with an earlier report relating sensory symptoms to maternal stress in older children with Asperger's syndrome (Epstein et al., 2008) and between SOR and family impairment in school-aged children with internalizing and/or externalizing psychopathologies and no ASD (Carter et al., 2012).

Although average levels of family impairment and parenting stress did not change over time, there was significant variation around their slopes, suggesting that individuals had varying rates of change over time. Interestingly, higher SOR scores were associated with less change in family variables. These findings may be explained by the fact that families with elevated SOR started and stayed higher on both measures than those families with toddlers with lower SOR. Thus, the persisting initially high levels of parenting stress and family impairment in the SOR group may have left less room for change. The low mean magnitude of change in family variables may be different in a more socio-economically diverse sample. This sample was a fairly demographically homogeneous group of families from predominantly white, upper to upper-middle class, and high education backgrounds.

Differences in maternal stress levels and family life restrictions between SOR and Non-SOR groups were noteworthy. What appears to be unique to families of children with ASD and SOR is the need to adapt activities and routines to cope with/avoid the child's sensitivities during self-care activities, feeding, and outdoor activities. SOR can lead to tantrums and irritability in children, as evidenced in this sample by elevated externalizing and anxiety scores. Mothers may search for ways to minimize their child's disruptive behavior and/or distress using strategies such as redesigning routines (e.g., vacuum when child is at school), social activities (e.g., avoid outings to malls or family events), and home environments (e.g., lock closets, place trampoline in yard) to prevent encounters with the sensory stimuli that trigger their child's over-response (Werner DeGrace, 2004).

In the current study, SOR predicted family variables above and beyond most child diagnostic (i.e., ADOS social-communication scores), emotional and behavioral (i.e., ITSEA externalizing and anxiety scores) scales. This is in contrast with evidence showing that ASD

symptoms contribute to parenting stress and family functioning in young children (Herring et al., 2006; Osborne & Reed, 2009). The fact that SOR appears to contribute to family impairment and parenting stress more proximally than other child factors may relate to the practical implications a child's sensitivity poses to family daily activities and routines. The young age of the current sample compared to previous family studies and the relatively low levels of clinically significant emotional and behavioral problems (see Table 1) may explain, in part, why behavior problems were not more strongly associated with family impairment and parenting stress. These problems may increase with age (Barker et al., 2011) and become more dominant in predicting interference in family activities. Further research is needed to address later family outcomes. In addition, relying upon a single-parent informant for both child and family characteristics is a limitation of this report. Although we in part controlled for reporting bias by including maternal report of affective symptoms as a covariate, there is need to validate current findings utilizing multi-source, multi-method assessments for both child and family factors.

Although the tested models investigated how SOR predicted changes in family life, we must acknowledge the possible contribution of parenting stress and restrictions of activities to the display of SOR behaviors. Parenting stress may lead the parent to over-respond to their child's behavior, respond in a less co-regulated and sensitive manner, and be less effective in applying self- and child-directed coping strategies. The manner in which parents set up the physical and social environment will determine the sensory experiences of the child (e.g., choose loud outing places as opposed to quieter ones, organize toys in an orderly versus chaotic manner, buy clothing without seams and tags). Thus there is need for future research to examine how family factors such as stress, routines, and the coping strategies parents apply to prevent or reduce their children's sensory symptoms influence the severity of sensory symptoms.

Conclusions

SOR contributes to family life impairment above and beyond ASD symptoms and maternal affective symptoms. This study supports the evaluation of family well-being and SOR during the assessment of toddlers with ASD. It is important to monitor maternal stress particularly for young children with ASD who show extreme SOR. As not all mothers of toddlers with SOR showed elevated stress and family restrictions, further research can explain the resilience of those families. This study calls for the design of early interventions that emphasize family education and partnership to address sensory symptoms in a way that matches the family's psychological and practical context.

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Figure 1.

A Latent Growth Curve Model of SOR Predicting to FLIS with a Latent Maternal Affective Symptoms Covariate

Note. $^{\dagger} p < .06$. $^{*} p < .05$. $^{**} p < .001$.

a The negative correlation results from the lower SOR ITSP score denoting a higher frequency and the higher FLIS score denoting more restrictions.

Figure 2.

A Latent Growth Curve Model of SOR Predicting to PSI with a Latent Maternal Affective Symptoms Covariate

Note. [†] $p < .06$. * $p < .05$. ** $p < .001$.

a The negative correlation results from the lower SOR ITSP score denoting a higher frequency and the higher FLIS score denoting more restrictions.

Table 1

Descriptive statistics for main study variables between SOR groups at Time 1 and (where applicable) Times 2 and 3

	Time 1			Time 2			Time 3		
	SOR (n = 55) Mean (SD)	Non SOR (n = 111) Mean (SD)	Wald Test	SOR (n = 51) Mean (SD)	Non SOR (n = 96) Mean (SD)	Wald Test	SOR (n = 33) Mean (SD)	Non SOR (n = 52) Mean (SD)	Wald Test
ADOS (social + communication standardized) ^A	51.23 (18.84)	58.48 (17.51)	5.80 [*]	—	—	—	—	—	—
Mullen composite	68.95 (19.26)	65.03 (13.77)	1.82	—	—	—	—	—	—
ITSEA Anxiety	0.43 (0.3)	0.25 (0.19)	16.05 ^{**}	—	—	—	—	—	—
ITSEA Externalizing	0.67 (0.3)	0.42 (0.82)	27.78 ^{**}	—	—	—	—	—	—
BAI ^A	9.07 (7.65)	5.70 (5.48)	8.56 [*]	—	—	—	—	—	—
CES-D ^B	16.18 (11.01)	12.81 (9.47)	3.78 [†]	—	—	—	—	—	—
FLIS	9.23 (5.13) _a	5.65 (3.98) _b	20.69 ^{**}	8.85 (4.64) _a	6.46 (4.19) _b	9.45 [*]	8.87 (4.59) _a	6.39 (4.34) _b	6.16 [*]
PSI	91.96 (21.17) _a	79.96 (19.83) _b	12.29 ^{**}	92.53 (19.67) _a	83.982 (20.00) _b	5.82 [*]	92.64 (20.46) _a	85.78 (23.32) _b	4.38 [*]

Note.

[†] $p < .06$.^{*} $p < .05$.^{**} $p < .001$ for between group comparisons. Same subscripts in a row indicate non-significant differences between means using the Wald Test of Parameter Constraints.^A 20% above moderate cutoff of 22 in SOR group versus 7% in Non-SOR.^B 44% above cutoff of 16 in SOR group versus 32% in Non-SOR.