Sensory Features and Family Functioning in Families of Children With Autism and Developmental Disabilities: Longitudinal Associations

Anne V. Kirby, Kathryn L. Williams, Linda R. Watson, John Sideris, John Bulluck, Grace T. Baranek

Importance: Children with autism spectrum disorder (ASD) and other developmental disabilities (DD) commonly display unusual responses to sensory input. Previous work has suggested concurrent associations linking sensory features with aspects of family functioning, including activity participation and caregiver strain. What is unknown, however, is the extent to which sensory features affect family functioning over time, as well as the influence of received services on these relationships.

Objective: To assess hypothesized longitudinal associations between sensory features and family functioning and examine interactions by group and service usage (i.e., educational and therapy services).

Design: Multigroup longitudinal observational study.

Setting: Community.

Participants: A volunteer sample of 81 children (50 with ASD, 31 with DD; 76% male), ages 2–12 yr, and their caregivers participated in assessments at two points, 3.3 yr apart on average.

Outcomes and Measures: Key measures included the Sensory Experiences Questionnaire, Sensory Profile, Sensory Processing Assessment for Young Children, Tactile Defensiveness and Discrimination Test–Revised, Caregiver Strain Questionnaire, and Home and Community Activities Scale. We also measured the amount of time children received educational and therapy services.

Results: Regression analyses confirmed long-term associations linking sensory features with aspects of activity participation and caregiver strain in this population; group and service usage interactions were also identified.

Conclusions and Relevance: Sensory features can affect the everyday experiences of both children and caregivers. It is important for practitioners to understand the potentially enduring effects of children's sensory features on family functioning so as to begin to identify supportive interventions with more optimal long-term effects.

Consideration of the factors influencing family functioning is crucial to understanding children's development and health (Jellett et al., 2015). In particular, research suggests that families of children with autism spectrum disorder (ASD) and other developmental disabilities (DD) have unique and varied experiences that warrant close examination to inform more effective interventions for children (Freuler et al., 2014; Hanna & Rodger, 2002) and family-centered care (Hodgetts et al., 2013; Kuhaneck et al., 2015). Some families may positively experience their child's ASD or other DD diagnosis (Blacher & Baker, 2007; Hastings et al., 2005), as evidenced through aspects of family resilience, including family closeness (Bayat, 2007) or a deeper sense of enrichment from caring for a child with a disability (Phelps et al., 2009).

Alternatively, reported negative consequences for families can include disruption in family routines (Schaaf et al., 2011) and activities (Mactavish & Schleien, 2004) as well as a strained ability to provide effective care (Kogan et al., 2008).

Several factors may contribute to experiences of families of children with ASD and other DD, including children's behavioral responses to sensory aspects of the environment (i.e., sensory features). Common atypical sensory features seen in both of these populations to varying degrees include hyperresponsiveness (i.e., overreactions to sensory input); hyporesponsiveness (i.e., underreactions to sensory input); and sensory interests, repetitions, and seeking behaviors (i.e., unusual or repetitive interactions with sensory input; Ausderau, Sideris, et al., 2014; Baranek et al., 2006; Ben-Sasson et al., 2009). Qualitative studies of children with ASD suggest that a child's sensory features can contribute positively or negatively to family experiences (Bagby et al., 2012; Schaaf et al., 2011). Moreover, recent quantitative studies have specifically identified some significant concurrent associations in ASD samples between sensory features and activity participation (Little et al., 2015) as well as caregiver strain (Kirby, White, & Baranek, 2015).

Little is known, however, about the more lasting effects of sensory features on family experiences in families of children with ASD and whether these features affect families of children with ASD and other DD in similar ways over time. Because sensory features may be relatively stable over time in children with ASD and other DD (Ausderau, Furlong, et al., 2014; McCormick et al., 2015), it is important to consider how these features relate to family functioning across development. The current study had two aims: (1) to determine longitudinal associations between children's sensory features and (a) their later participation in home and community activities and (b) parents' levels of caregiver strain and (2) to examine interactions by diagnostic group (ASD, DD) and amounts of service usage (educational and therapy services) over time.

Home and Community Activities

Families of children with ASD and other DD are known to have experiences distinct from those of children without disabilities, including altered family and child participation in home and community activities (Rao & Beidel, 2009). In particular, research suggests that children with DD may participate less than their peers in home, school, and leisure activities (Van Naarden Braun et al., 2006). Moreover, children with ASD differ from both their peers with other DD and those with typical development in that they generally participate less across multiple domains, including self-care, leisure, community mobility, social interaction, and household chores (Askari et al., 2015; LaVesser & Berg, 2010; Marquenie et al., 2011).

Sensory features, which are commonly exhibited by children with ASD and other DD (Baranek et al., 2006), may limit or change the way families participate in various activities and routines. Little and colleagues (2015) identified significant concurrent associations between sensory features and the home and community activity participation of children with ASD; specifically, children's hyperresponsiveness was associated with limited activity participation, especially in activities outside the home compared with parent–child activities. Children's hyporesponsiveness was associated with increased activities outside (vs. inside) the home, whereas sensory interests, repetitions, and seeking behaviors were associated with more activity participation inside the home. Reynolds and colleagues (2011) also identified decreased competence in activity participation among children with hyperresponsiveness in a combined group of children with and without ASD, but they did not find correlations for the other two sensory patterns.

Caregiver Strain

An understanding of the experiences of families of children with ASD and other DD can also be gained by examining stress experienced by parents. Parents of children with DD are suggested to experience high levels of caregiver strain (Gupta, 2007), with further elevated levels seen among parents of children with ASD (Estes et al., 2009; Hayes & Watson, 2013; Plant & Sanders, 2007; Rao & Beidel, 2009). Previous work suggests that sensory features may have significant concurrent associations with levels of caregiver strain among ASD groups. Epstein and colleagues (2008) identified a significant moderate correlation between overall parent stress (on the Parenting Stress Index–Short Form; Abidin, 1995) for mothers of children with Asperger disorder and overall child sensory dysfunction (on the Short Sensory Profile; Dunn, 1999), indicating more stress among mothers of children with more overall sensory symptoms.

Research conducted by Kirby, White, and Baranek (2015) on distinct sensory features further suggested that increased levels of both hyperresponsiveness and hyporesponsiveness contributed to increased objective strain (i.e., negative observable consequences) among caregivers of children with ASD. Hyperresponsiveness was also found to be positively related to subjective internalized strain (i.e., negative feelings experienced internally, such as sadness) for caregivers of children with ASD. Of interest is that the researchers also found a negative correlation between objective strain and sensory interests, repetitions, and seeking behaviors, implying that higher levels of these behaviors were associated with fewer stressful observable consequences for caregivers concurrently.

What remains unexplored, however, is the longer term impact of sensory features on the daily lives of families of children with ASD and other DD. Longitudinal research is needed to better inform interventions with potential for longer term effects on family participation and to establish a stronger link between specific sensory features early in childhood and later family outcomes such as participation in home and community activities and caregiver strain.

Study Purpose

The purpose of this study was to determine the longitudinal associations between early sensory features across three sensory response patterns (i.e., hyperresponsiveness [HYPER], hyporesponsiveness [HYPO], and sensory interests, repetitions, and seeking behaviors [SIRS]) in children with ASD and other DD and later family outcomes (i.e., home and community activity participation and caregiver strain). On the basis of previous cross-sectional literature, our primary hypothesis was that higher baseline sensory scores based on both parent-report and observational assessment measures would have more negative consequences over time and that these effects would be greater for the ASD than the other DD group.

We also aimed to examine the extent to which differing educational and therapy service usage over time (as reported by caregivers) moderated these findings. Because children with ASD and other DD typically receive a variety of educational and therapy services that focus most directly on child outcomes, we felt it important to explore the impact of service usage on family outcomes to inform implications for practice and future research. Thus, we hypothesized that the amount of services received between the two time points would mitigate the long-term negative consequences of sensory features on family outcomes.

Method

In this longitudinal study we used data collected from children and their caregivers at two time points. The analyses presented here were planned from the outset of a larger research project encompassing multiple aims related to understanding the sensory experiences of children with ASD, other DD, and typical development. The study was purely descriptive; no interventions or services were provided in conjunction with this research. Families constituted a community sample recruited by means of study flyers and information disseminated through multiple sources, such as a university research participant registry, schools, developmental evaluation clinics, and parent advocacy groups. Families received monetary incentives for their participation, ranging from $20 to $75 at each time point, depending on the number of assessments. The number of assessments varied, depending on time point (e.g., ASD diagnostic measures were administered only at the first time point), diagnosis (additional assessments were used to characterize the ASD phenotype in children with ASD that were not needed with children with other DD), and child's age (e.g., cognitive measures were validated for specific age ranges). A university institutional review board approved the study, and all recommended data security and informed consent and assent procedures were upheld.

Participants

Eighty-one children (ASD, *n* = 50; DD, *n* = 31), ages 2–12 yr, and their caregivers were included in the study. Children were assessed at two time points, at an average age of approximately 6 and 9 yr, respectively. See Table 1 for detailed characteristics of the sample. Each time, children participated in a full standardized evaluation that included diagnostic, developmental, and sensory measures. A primary caregiver for each child completed questionnaires and participated in a structured interview about services his or her child had used; the same caregiver completed assessments at each time point. The ASD group entered with a diagnosis of ASD made by an independent licensed psychologist or physician (e.g., psychiatrist, developmental pediatrician); project staff confirmed diagnoses using the Autism Diagnostic Interview–Revised (LeCouteur et al., 2003) and Autism Diagnostic Observation Schedule (Lord et al., 1999).

Inclusion in the DD group required overall cognitive scores at least 2 standard deviations (*SD*) below the mean, or delays (≥1.5 *SD* below the mean) in two areas of development (i.e., adaptive behavior, receptive or expressive language, fine or gross motor, visual reception). The DD group included children with known genetic syndromes, idiopathic developmental delays, or delays related to prematurity; children were excluded from the DD group if they had been diagnosed with ASD or met criteria for autism on the Childhood Autism Rating Scale (Schopler et al., 1988). Children were excluded from the study if they had genetic conditions that have substantial overlap with ASD (e.g., Fragile X syndrome, tuberous sclerosis) or if they had a seizure disorder; significant motor, visual, or hearing impairments (uncorrected); or a mental age <6 mo because these children would have limited capabilities to complete the observational assessments.

Table 1. Sample Characteristics

	M* (*SD*) or *n	
Characteristic	**ASD (*n* = 50)**	**DD (*n* = 31)**
Age (yr) at T1	5.46 (2.23)	6.06 (2.77)
Age (yr) at T2	8.98 (2.12)	9.08 (2.18)
Years between time points	3.51 (1.29)	3.02 (1.21)
IQ proxy	70.28 (22.85)	60.37 (18.25)
Gender		
Female	8	11
Male	42	20
Race/ethnicity		
Asian	1	1
African-American	3	3
White	43	25
Hispanic	9	1
Other	3	2
Mother's highest level of education		
High school graduate/GED	10	8
Associate degree, technical training, or partial college	8	2
Bachelor or advanced degree	32	21
Household yearly income		
<$60,000	15	15
$60,000–$99,999	21	9
>$99,999	14	7

Note. ASD = autism spectrum disorder; DD = other developmental disabilities; GED = general equivalency diploma; *M* = mean; *SD* = standard deviation; T1 = Time 1; T2 = Time 2.

Instruments

Assessments were administered by trained and experienced research staff, typically over the course of two visits per time point. Those relevant to the present analysis included parent-report and observational sensory measures, developmental cognitive assessments, outcome measures on activity participation and caregiver strain, and a structured parent interview about services. Descriptive statistics for key study variables are listed in Table 2.

Sensory Processing Measures.

Scores on two parent-report and two observational measures were averaged to create a parent-report score and an observational score for HYPER, HYPO, and SIRS. Using multiple measures can help produce more reliable measurement estimates of the underlying constructs of interest. Caregivers of study participants completed the Sensory Experiences Questionnaire (Version 3.0; Baranek, 2009) and the Sensory Profile (Dunn, 1999), consisting of 105 and 125 items, respectively, rated on a 5-point scale. Both questionnaires measure frequencies of children's unusual responses to sensory stimuli during daily activities and routines across modalities. We removed irrelevant items from the Sensory Profile before combined score calculation using an in-depth process undertaken to ensure content validity for the three sensory patterns (see Boyd et al., 2010, and Watson et al., 2011, for further details). Previous work has validated these tools for measurement of the three patterns of interest for children with ASD and other DD (Ausderau, Sideris, et al., 2014; Kientz & Dunn, 1997; Little et al., 2011). In addition, two observational measures of sensory features were conducted with the children during laboratory visits. The Sensory Processing Assessment for Young Children (Baranek, 1999) is administered during a 20-min structured play session involving behavioral presses for the three sensory constructs of interest. The Tactile Defensiveness and Discrimination Test–Revised (Baranek, 1998) is a

Table 2. Descriptive Statistics for Key Study Variables

Study Variables	***M* (*SD*) or *n***	
	ASD (*n* = 50)	**DD (*n* = 31)**
Sensory scores (possible range = 1–5)		
SIRS (parent-report measures)	2.49 (0.51)	2.15 (0.56)
SIRS (observational measures)	2.39 (0.53)	2.24 (0.56)
HYPER (parent-report measures)	2.42 (0.49)	2.07 (0.45)
HYPER (observational measures)	2.24 (0.35)	2.17 (0.34)
HYPO (parent-report measures)	2.23 (0.56)	1.86 (0.42)
HYPO (observational measures)	2.23 (0.53)	1.68 (0.56)
HCAS scores (possible range = 0–3)		
f1: Parent–Child Household Activities	1.89 (0.50)	2.19 (0.41)
f2: Community Activities	0.61 (0.30)	0.68 (0.24)
f3: Routine Errands	1.43 (0.50)	1.63 (0.60)
f4: Neighborhood–Social Activities	0.85 (0.47)	1.00 (0.56)
f5: Outdoor Activities	0.52 (0.46)	0.70 (0.49)
f6: Faith-Based Activities	1.10 (0.78)	1.34 (0.74)
CGSQ scores (possible range = 1–5)		
Objective strain	2.22 (0.90)	2.13 (0.94)
Subjective internal strain	1.63 (0.57)	1.57 (0.68)
Subjective external strain	2.88 (1.08)	2.55 (1.04)
Total hr of services between time points		
Therapy services	328.05	317.39
Educational services	2,897.39	3,203.72

Note. Sensory scores were averaged across measures: Parent-report measures were from the Sensory Experiences Questionnaire and Sensory Profile; observational measures were from the Sensory Processing Assessment for Young Children and the Tactile Defensiveness and Discrimination Test–Revised. ASD = autism spectrum disorder; CGSQ = Caregiver Strain Questionnaire; DD = other developmental disabilities; f = factor; HCAS = Home and Community Activities Scale; HYPER = hyperreactivity; HYPO = hyporeactivity; *M* = mean; *SD* = standard deviation; SIRS = sensory interests, repetitions, and seeking behaviors.

15-min observational assessment that measures tactile hyperresponsiveness and discrimination. Strong interrater reliability was established with both observational measures; assessments were video recorded and a random 20% were scored by a second blind coder with >80% reliability.

Cognitive Measures.

Children in both groups received a standardized cognitive assessment, either the Mullen Scales of Early Learning (Mullen, 1995), given to children age <68 mo, or the Stanford–Binet Intelligence Scales (Roid, 2003), given to older children. Both assessments are examiner administered, standardized assessments. Using these assessments, each child's nonverbal mental age was calculated. Scores were transformed into a developmental quotient (i.e., IQ proxy) using the following formula: nonverbal mental age ÷ chronological age × 100, to reduce floor effects on standard scores.

Services.

Extensive data on the amounts and types of services children used were collected using a structured parent interview conducted by a trained assessor at both time points. To address our research questions, we were interested specifically in the educational and therapy services children used. We calculated two between-time point service usage variables, based on parent report: the total number of hours of traditional therapy services (i.e., occupational, speech–language, and physical therapy) and the total number of hours of special educational services (e.g., early intervention, applied behavior analysis, and school-based treatments, excluding occupational, speech–language, and physical therapy services because these were coded in the previous category).

Outcome Measures.

Family outcomes were measured using the Caregiver Strain Questionnaire (CGSQ; Brannan et al., 1997) and the Home and Community Activities Scale (HCAS; Dunst et al., 2000). The CGSQ is a 21-item self-report questionnaire that has demonstrated success in measuring three types of strain among caregivers of children with ASD (Khanna et al., 2012). The three strain types, which have been identified and confirmed using factor analytic techniques in numerous studies (Brannan et al., 1997; Khanna et al., 2012; Kirby, White, & Baranek, 2015), include (1) subjective internalized strain (i.e., experiencing negative feelings, such as sadness or worry for the future), (2) subjective externalized strain (i.e., negative feelings directed toward the child, such as anger, resentment, or embarrassment), and (3) objective strain (i.e., observable negative consequences, such as those regarding time, work, finances, health, or relationships). On the CGSQ, caregivers rate how often they have experienced particular situations or feelings in the past 6 mo on a scale that ranges from 1 (*almost never*) to 5 (*almost always*).

The HCAS is an 83-item caregiver-report questionnaire that measures the frequency of participation in a wide range of home and community activities (Dunst et al., 2000). We used the adapted response options, which have been used in prior studies of children with ASD (Little et al., 2014), to determine frequency of participation on each item (range = 0 [*never*] to 3 [*daily*]). We also used the six activity domains identified by Little et al. (2014) through factor analysis with a national sample of children with ASD: Parent–Child Household Activities, Community Activities, Routine Errands, Neighborhood–Social Activities, Outdoor Activities, and Faith-Based Activities. See Table 3 for a list of the outcome factors of interest in this study with descriptors and examples.

Data Analysis

Data were double entered and error checked before analysis in SAS (Version 9.3; SAS Institute, Cary, NC). We ran a series of regression models to determine the longitudinal associations among the three sensory constructs of interest across parent-report and observational measures at Time 1 (T1) and the family outcomes of interest at Time 2 (T2). Diagnostic group (ASD vs. other DD) and educational and therapy services usage were explored as moderators; the

Table 3. Descriptors and Examples of Outcome Factors

Descriptor	Examples
HCAS	
f1: Parent–Child Household Activities	Picking up toys, reading, playtime
f2: Community Activities	Children's festivals, community celebrations
f3: Routine Errands	Running errands, going shopping, eating out
f4: Neighborhood–Social Activities	Swimming, visiting friends
f5: Outdoor Activities	Hiking, gardening
f6: Faith-Based Activities	Attending church, religious activities, praying
CGSQ	
Objective strain	Missing work, disruption of routines, financial strain
Subjective internal strain	Feeling sad, worried, guilty
Subjective external strain	Feeling angry, embarrassed; difficulty relating to child

Note. The HCAS factors used are based on Little et al.'s (2014) analysis; the CGSQ factors used are based on Brannan et al.'s (1997) and Khanna et al.'s (2012) analyses. CGSQ = Caregiver Strain Questionnaire; f = factor; HCAS = Home and Community Activities Scale.

following covariates were included: time elapsed between data collection points, child age at study start, child gender, child IQ proxy, household income, and mother's education. We took a step-down approach to determining whether and which interactions to retain in the final models; if the interaction term or terms in a given model were nonsignificant, we trimmed the model accordingly to increase clarity (Cohen et al., 2003). Thus, some final examined models included three-way interactions (Sensory Score × Group × Services), some included two-way interactions (Sensory Score × Group or Sensory Score × Services), and some involved no interactions (i.e., main effects models).

Results

The results indicated a variety of significant and nonsignificant associations between the variables of interest. For purposes of clarity, because of the number of factors tested, we focus here on the significant findings related to the prediction of sensory scores on the outcomes of interest. See Table 4 for an overview of what was significant and nonsignificant in our analyses. The relationship of our various study findings to our hypotheses is described in the Discussion section.

Activity Outcomes

HCAS and SIRS (Parent Report).

The majority of our significant findings related to the longitudinal prediction of activity outcomes were in the models including SIRS (parent-report) scores. For this predictor, three-way interaction terms (Sensory Score × Group ×

Table 4. Broad Summary of Significance for Key Analysis Terms, Including Three-Way Interactions, Two-Way Interactions, and Main Effects

Variable	HCAS f1	HCAS f2	HCAS f3	HCAS f4	HCAS f5	HCAS f6	CGSQ–OS	CGSQ–SIS	CGSQ–SES
SIRS (par)	S × G × E* S × G × T*	S × G × T**	—	S × G × E** S × G × T***	—	S × G × E*	S × G × T*	—	S × G × E* S × G × T**
SIRS (obs)	—	S × E*	—	S × G*	—	—	—	—	S × T* S × E**
HYPER (par)	—	—	—	—	—	S × G × E**	—	—	—
HYPER (obs)	—	—	—	—	—	—	—	S × E**	—
HYPO (par)	S*	S × G × E*	—	—	S × G × E*	—	—	—	S*
HYPO (obs)	—	—	—	—	—	—	—	—	S × E*

Note. This table summarizes significance of regression models run between sensory scores and outcome factors. — = not significant at $p < .05$; CGSQ = Caregiver Strain Questionnaire; E = educational services; f1 = Parent–Child Household Activities; f2 = Community Activities; f3 = Routine Errands; f4 = Neighborhood–Social Activities; f5 = Outdoor Activities; f6 = Faith-Based Activities; G = group; HCAS = Home and Community Activities Scale; HYPER = hyperresponsiveness; HYPO = hyporesponsiveness; obs = observational measures; OS = objective strain; par = parent-report measures; S = sensory score; SES = subjective external strain; SIRS = sensory interests, repetitions, and seeking behaviors; SIS = subjective internal strain; T = therapeutic services.
*$p < .05$.**$p < .01$.***$p < .001$.

Services) were significant with educational and therapy services for the prediction of T2 rates of Parent–Child Household Activities (HCAS factor 1 [f1]), educational services, *F*(1, 62) = 4.46, *B* (standard error [*SE*]) = −0.015 (0.007), *p* < .05; therapy services, *F*(1, 62) = 6.37, *B* (*SE*) = −0.002 (0.001), *p* < .05. We also found that higher service usage was generally associated with less participation in Parent–Child Household Activities. However, in the DD group SIRS scores significantly moderated that association; those with the highest SIRS scores and highest service usage reported the highest levels of participation in Parent–Child Household Activities. Similarly, three-way interaction terms were significant with both service types for the prediction of T2 rates of Neighborhood–Social Activities (HCAS f4), educational services, *F*(1, 62) = 13.20, *B* (*SE*) = −0.028 (0.008), *p* < .001; therapy services, *F*(1, 62) = 9.76, *B* (*SE*) = −0.003 (0.001), *p* < .01. Again, we saw that those with the highest SIRS scores and highest service usage (educational and therapy) in the DD group had the highest levels of participation in Neighborhood–Social Activities. We also identified a significant three-way interaction for SIRS (parent-report) scores, group, and therapy services when predicting Community Activities (HCAS f2), *F*(1, 62) = 7.42, *B* (*SE*) = −0.001 (0), *p* < .01. In this model, we observed opposite patterns by group: Higher SIRS scores and more therapy services were associated with lower rates of Community Activities among children with ASD but with higher rates of Community Activities among children with DD. Finally, we observed a significant three-way interaction with SIRS (parent-report), group, and educational services when predicting T2 Faith-Based Activities (HCAS f6), *F*(1, 62) = 5.00, *B* (*SE*) = 0.028 (0.013), *p* < .05. In this model, the most notable thing we observed was that children with DD who had the highest SIRS scores and lowest service usage participated the most in Faith-Based Activities.

HCAS and SIRS (Observational).

For the Community Activities outcome (HCAS f2), we observed a significant interaction of SIRS (observational) scores and educational services, *F*(1, 65) = 4.27, *B* (*SE*) = −0.004 (0.002), *p* < .05. This model demonstrated that, across groups, children with high SIRS (observational) scores and low educational service usage had higher rates of participation in Community Activities. Also, more service usage was associated with less participation in Community Activities overall. We also observed a significant interaction of SIRS (observational) scores by group for Neighborhood–Social Activities (HCAS f4), *F*(1, 65) = 2.91, *B* (*SE*) = 0.450 (0.220), *p* < .05; specifically, in the DD group higher observed SIRS scores were associated with slightly lower rates of participation in Neighborhood–Social Activities; however, the DD group in general participated more in these activities than the ASD group.

HCAS and HYPER (Parent Report).

Regarding Faith-Based Activities (HCAS f6), we observed a significant three-way interaction with HYPER (parent-report) scores, group, and educational services, *F*(1, 62) = 7.84, *B* (*SE*) = 0.063 (0.022), *p* < .01. The association is similar to that of the SIRS (parent-report) prediction of HCAS f6; of note is that children with DD who had the highest HYPER scores and lowest educational service usage had the highest rates of participation in Faith-Based Activities.

HCAS and HYPO (Parent Report).

We observed a significant main effect demonstrating that increased HYPO (parent-report) scores at T1 were associated with less participation in Parent–Child Household Activities (HCAS f1) at T2, *F*(1, 68) = 4.87, *B* (*SE*) = −0.210 (0.100), *p* < .05. When predicting Community Activities (HCAS f2) and Outdoor Activities (HCAS f5), we identified significant three-way interactions with HYPO (parent-report) scores, group, and educational services, f2, *F*(1, 62) = 4.08, *B* (*SE*) = 0.011 (0.006), *p* < .05; f5, *F*(1, 62) = 4.78, *B* (*SE*) = 0.023 (0.011), *p* < .05. Children with ASD who had the highest HYPO (parent-report) scores and highest service usage participated the least in Community Activities.

Caregiver Strain Outcomes

CGSQ and SIRS (Parent Report).

We observed significant three-way interactions in parent-reported SIRS score models. A SIRS Score × Group × Therapy Services interaction was significant in predicting caregivers' level of objective strain, $F(1, 62) = 5.81$, B (SE) = 0.004 (0.002), $p < .05$. In this model, caregivers of children with DD who had the highest SIRS scores and lowest service usage reported the highest objective strain (e.g., strains on time and finances). When predicting caregivers' level of subjective external strain (e.g., anger toward child), SIRS Score × Group × Services interactions were significant for both service types, educational, $F(1, 61) = 5.03$, B (SE) = 0.038 (0.017), $p < .05$; therapy, $F(1, 61) = 7.92$, B (SE) = 0.005 (0.002), $p < .01$. For both service types, caregivers of children with DD who had the highest SIRS scores and highest service usage reported the lowest levels of subjective external strain.

CGSQ and SIRS (Observational).

The results regarding SIRS (observational) scores predicting caregivers' subjective external strain indicated that caregivers of children with the highest SIRS (observational) scores had the most strain, regardless of group. We identified SIRS × Services interaction effects for both service types, educational, $F(1, 64) = 8.51$, B (SE) = 0.023 (0.008), $p < .01$; therapy, $F(1, 65) = 5.92$, B (SE) = 0.002 (0.001), $p < .05$, suggesting that higher service usage was associated with slightly increased levels of subjective external strain for caregivers of children with higher SIRS scores across groups.

CGSQ and HYPER (Observational).

When predicting subjective internal strain, we identified a two-way interaction of HYPER (observational) Scores × Educational Services, $F(1, 64) = 8.54$, B (SE) = 0.025 (0.008), $p < .01$. Caregivers of children across groups with the highest HYPER scores and highest educational service usage had the highest levels of subjective internal strain. Less internal strain was identified among caregivers of children with either (1) low HYPER scores and high educational service usage or (2) high HYPER scores and low educational service usage.

CGSQ and HYPO (Parent Report).

We identified a significant main effect suggesting that caregivers of children with higher HYPO (parent-report) scores had increased levels of subjective external strain, $F(1, 67) = 6.32$, B (SE) = 0.580 (0.230), $p < .05$.

CGSQ and HYPO (Observational).

A significant HYPO (observational) × Educational Services interaction when predicting caregivers' subjective external strain, $F(1, 64) = 6.06$, B (SE) = 0.019 (0.008), $p < .05$, suggested that caregivers of children with the highest HYPO scores and the highest service usage had the highest levels of subjective external strain.

Discussion

In this study, we tested associations among three commonly observed sensory response patterns and measures of family functioning across time among families of children with ASD and other DD. The step-down approach to analysis allowed for the further exploration of two moderators of this association: diagnostic group (ASD/DD) and service usage (educational and therapy services) as reported by caregivers. We identified several significant findings that expand our knowledge about sensory features and their associations with family activity participation and caregiver strain. The majority of the significant findings were identified with the parent-report sensory measures, which may be related to the fact that the outcome measures used a parent-report format as well. Observed sensory patterns may be more related to observed outcomes, which could be explored in future studies.

Our general hypothesis that higher sensory scores would be associated with less activity participation and more caregiver strain was largely consistent with previous cross-sectional literature. However, we found mixed support for our hypotheses that these relationships would be stronger in the ASD group, because they were found to vary in complex three-way interactions. Finally, we found evidence opposing our hypothesis that higher service usage would mitigate some of the negative consequences, which was the most surprising finding in this study. These summative comments are further explicated in the paragraphs that follow.

Consistent with Little et al.'s (2015) cross-sectional findings, we noted that children with high HYPO scores had less participation, longitudinally, in parent–child household activities. We identified that increased SIRS and HYPO scores were associated with increased subjective external strain longitudinally, whereas Kirby, White, and Baranek (2015) reported associations with increases in objective strain in cross-sectional analyses. This difference may suggest that the feelings parents have toward their children change more over time, whereas restrictions on things such as time and finances are affected in more short-term ways. Finally, no significant longitudinal associations were identified in our analyses between sensory features and participation in routine errands. This contrasts with the results of Little and colleagues, who identified that increased HYPER scores among children with ASD were associated with less frequent participation in routine errands concurrently. Taken together, these variations in results may indicate that sensory features affect families in varying ways concurrently versus over time.

It is interesting that we identified that higher sensory scores at T1 were associated with greater participation in faith-based activities at T2, most consistently among children with DD who had relatively high SIRS or HYPER scores and low service usage. It is possible that families of children who present with these impactful sensory features tend to seek support in faith communities that are inclusive, understanding, and supportive. Bayat (2007) suggested that strengthened or new spiritual or religious beliefs are a common aspect of family resilience, which may have contributed to this finding.

Contrary to what we hypothesized, across multiple analyses, the more services a child with ASD was reported to have received between time points, the less activity participation was reported at T2. This may suggest that these children have high service usage because they have challenges that limit their ability to safely and successfully participate in community activities. Alternatively, some children with ASD may be spending such large amounts of time receiving services that they have less available time for participation in other activities in their home and community. It is interesting that higher rates of activity participation were noted for children in the DD group who had high service usage coupled with high SIRS scores; thus, diagnosis (DD vs. ASD) and types of sensory behaviors may affect the ways families choose, or are able, to engage in activities. In general, higher SIRS scores were found across multiple analyses to be associated with higher activity participation in the DD group. This may suggest that SIRS behaviors may be somewhat protective for this group and facilitate engagement in home and community activities. That this finding was not consistent in the ASD group may reflect differences in the nature and complexity of SIRS behaviors across groups (i.e., more complex in ASD than DD) that have been identified in previous observational research and are not fully accounted for in this analysis focused on SIRS frequency (Kirby, Little, et al., 2015).

As stated earlier, our general findings suggest that higher service usage was associated with less activity participation and more caregiver strain over time, which surprised us. Clinical experience leads us to consider many reasons underlying families' utilization and stoppage of services, which are not controlled for in correlational studies such as this one. One explanation of our findings is that perhaps the amounts of time spent in educational or therapy services, along with the stress of managing multiple services for children with disabilities, are potential barriers for families. However, previous studies have suggested that children with higher autism severity received higher numbers of treatment types (Green et al., 2006), and those with higher sensory symptoms received earlier treatment (Patten et al., 2013). Thus, one possible explanation for our finding is that greater disability (measured here as severity of sensory features) contributes to lower rates of activity participation and greater caregiver strain, as well as overall higher service usage. Because this was a longitudinal, correlational study, we cannot infer causation; thus, there is a need for more controlled intervention studies in the future to determine whether specific interventions may mitigate or exacerbate specific consequences for families.

Limitations and Future Research

There are a few limitations to consider here. As is the case with all correlational work, we cannot determine causality of the associations found in the current study even though the study was longitudinal. Our approach allowed for exploration of the potential contributions of service usage to the association between sensory features and family functioning outcomes. Further work should include well-designed intervention studies to examine the role of specific services and dosage of services on family outcomes as well as potential moderators. In addition, because we tested individual factors for all of our constructs of interest (i.e., sensory features, home and community activities, caregiver strain) as well as two specific moderators related to service usage, our analysis involved a high number of statistical models that may have inflated Type I error rates. Although we consider our methods advantageous for fully examining the complexity in our data and addressing our hypotheses, as well as for reducing the potential for Type II error, our findings should nevertheless be interpreted with caution and warrant replication with larger samples.

We explored caregiver strain and activity participation as separate outcomes both related to family functioning. In the future, researchers should consider exploring activity participation and caregiver strain within the same models because there is some evidence to suggest they may influence each other. Some previous literature suggests that parents of children with ASD and other DD have reported that when participation does occur, it may sometimes increase stress (Dickie et al., 2009; Lam et al., 2010; Marquenie et al., 2011). For example, difficulty with family routines, such as mealtime and bedtime, and managing challenging behaviors manifested during these activities, as well as level of disability, have all been reported as significant contributing factors to parent stress (Plant & Sanders, 2007).

Implications for Occupational Therapy Practice

Our findings suggest that children with ASD and other DD and their families may need additional support to positively engage in home and community activities and to reduce caregiver strain. Occupational therapy practitioners should consider the following recommendations when working with these populations:

- Practitioners should factor in the implications of children's specific diagnosis for the amount of time they spend receiving services and provide families with recommendations about how to build positive engagement in home and community activities into their routines.
- Put more specifically, practitioners need to consider the extent to which there could be trade-offs between community participation and intensity and duration of therapeutic services; for example, are children with ASD who receive high amounts of services potentially missing opportunities to participate in natural home and community activities with their families? Therapy carryover activities should be designed to fit each family's routines and needs to avoid placing additional stress on caregivers and allow sufficient time for home and community activity participation.
- Practitioners should be aware that parent reports about sensory features may differ from professional observations and that the relationships of each to different types of outcome measures may differ as well; thus, it is critical to conduct a comprehensive evaluation to understand the impact sensory features may be having on current and future child and family functioning.
- Practitioners should maintain awareness that sensory features can influence both child and family, and these impacts may differ across individuals and by diagnosis. These effects may be different in short-term versus long-term ways. Taking a family-centered approach to care can ensure child and family needs are addressed comprehensively.

References

Abidin, R. R. (1995). *Parenting stress index* (3rd ed.). Charlottesville, VA: Pediatric Press.

Askari, S., Anaby, D., Bergthorson, M., Majnemer, A., Elsabbagh, M., & Zwaigenbaum, L. (2015). Participation of children and youth with autism spectrum disorder: A scoping review. *Review Journal of Autism and Developmental Disorders*, *2*, 103–114. https://doi.org/10.1007/s40489-014-0040-7

Ausderau, K. K., Furlong, M., Sideris, J., Bulluck, J., Little, L. M., Watson, L. R., . . . Baranek, G. T. (2014). Sensory subtypes in children with autism spectrum disorder: Latent profile transition analysis using a national survey of sensory features. *Journal of Child and Adolescent Psychology and Psychiatry*, *55*, 935–944. https://doi.org/10.1111/jcpp.12219

Ausderau, K., Sideris, J., Furlong, M., Little, L. M., Bulluck, J., & Baranek, G. T. (2014). National survey of sensory features in children with ASD: Factor structure of the Sensory Experience Questionnaire (3.0). *Journal of Autism and Developmental Disorders*, *44*, 915–925. https://doi.org/10.1007/s10803-013-1945-1

Bagby, M. S., Dickie, V. A., & Baranek, G. T. (2012). How sensory experiences of children with and without autism affect family occupations. *American Journal of Occupational Therapy*, *66*, 78–86. https://doi.org/10.5014/ajot.2012.000604

Baranek, G. T. (1998). *Tactile Defensiveness and Discrimination Test–Revised.* Unpublished manuscript, University of North Carolina, Chapel Hill.

Baranek, G. T. (1999). *Sensory Processing Assessment for Young Children*. Unpublished manuscript, University of North Carolina, Chapel Hill.

Baranek, G. T. (2009). *Sensory Experiences Questionnaire* (Version 3.0). Unpublished manuscript, University of North Carolina, Chapel Hill.

Baranek, G. T., David, F. J., Poe, M. D., Stone, W. L., & Watson, L. R. (2006). Sensory Experiences Questionnaire: Discriminating sensory features in young children with autism, developmental delays, and typical development. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *47*, 591–601. https://doi.org/10.1111/j.1469-7610.2005.01546.x

Bayat, M. (2007). Evidence of resilience in families of children with autism. *Journal of Intellectual Disability Research*, *51*, 702–714. https://doi.org/10.1111/j.1365-2788.2007.00960.x

Ben-Sasson, A., Hen, L., Fluss, R., Cermak, S. A., Engel-Yeger, B., & Gal, E. (2009). A meta-analysis of sensory modulation symptoms in individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *39*, 1–11. https://doi.org/10.1007/s10803-008-0593-3

Blacher, J., & Baker, B. L. (2007). Positive impact of intellectual disability on families. *American Journal of Mental Retardation*, *112*, 330–348. https://doi.org/10.1352/0895-8017(2007)112[0330:PIOIDO]2.0.CO;2

Boyd, B. A., Baranek, G. T., Sideris, J., Poe, M. D., Watson, L. R., Patten, E., & Miller, H. (2010). Sensory features and repetitive behaviors in children with autism and developmental delays. *Autism Research*, *3*, 78–87. https://doi.org/10.1002/aur.124

Brannan, A., Heflinger, C., & Bickman, L. (1997). The Caregiver Strain Questionnaire: Measuring the impact on the family of living with a child with serious emotional disturbance. *Journal of Emotional and Behavioral Disorders*, *5*, 212–222. https://doi.org/10.1177/106342669700500404

Cohen, J., Cohen, P., West, S. G, & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Mahwah, NJ: Erlbaum.

Dickie, V. A., Baranek, G. T., Schultz, B., Watson, L. R., & McComish, C. S. (2009). Parent reports of sensory experiences in preschool children with and without autism: A qualitative study. *American Journal of Occupational Therapy*, *63*, 172–181. https://doi.org/10.5014/ajot.63.2.172

Dunn, W. (1999). *Sensory Profile manual.* San Antonio: Psychological Corporation.

Dunst, C. J., Hamby, D., Trivette, C. M., Raab, M., & Bruder, M. B. (2000). Everyday family and community life and children's naturally occurring learning opportunities. *Journal of Early Intervention*, *23*, 151–164. https://doi.org/10.1177/10538151000230030501

Epstein, T., Saltzman-Benaiah, J., O'Hare, A., Goll, J. C., & Tuck, S. (2008). Associated features of Asperger syndrome and their relationship to parenting stress. *Child: Care, Health and Development*, *34*, 503–511. https://doi.org/10.1111/j.1365-2214.2008.00834.x

Estes, A., Munson, J., Dawson, G., Koehler, E., Zhou, X. H., & Abbott, R. (2009). Parenting stress and psychological functioning among mothers of preschool children with autism and developmental delay. *Autism*, *13*, 375–387. https://doi.org/10.1177/1362361309105658

Freuler, A. C., Baranek, G. T., Tashjian, C., Watson, L. R., Crais, E. R., & Turner-Brown, L. M. (2014). Parent reflections of experiences of participating in a randomized controlled trial of a behavioral intervention for infants at risk of autism spectrum disorders. *Autism*, *18*, 519–528. https://doi.org/10.1177/1362361313483928

Green, V. A., Pituch, K. A., Itchon, J., Choi, A., O'Reilly, M., & Sigafoos, J. (2006). Internet survey of treatments used by parents of children with autism. *Research in Developmental Disabilities*, *27*, 70–84. https://doi.org/10.1016/j.ridd.2004.12.002

Gupta, V. B. (2007). Comparison of parenting stress in different developmental disabilities. *Journal of Developmental and Physical Disabilities*, *19*, 417–425. https://doi.org/10.1007/s10882-007-9060-x

Hanna, K., & Rodger, S. (2002). Towards family-centred practice in paediatric occupational therapy: A review of the literature on parent-therapist collaboration. *Australian Occupational Therapy Journal*, *49*, 14–24. https://doi.org/10.1046/j.0045-0766.2001.00273.x

Hastings, R. P., Beck, A., & Hill, C. (2005). Positive contributions made by children with an intellectual disability in the family: Mothers' and fathers' perceptions. *Journal of Intellectual Disabilities*, *9*, 155–165. https://doi.org/10.1177/1744629505053930

Hayes, S. A., & Watson, S. L. (2013). The impact of parenting stress: A meta-analysis of studies comparing the experience of parenting stress in parents of children with and without autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *43*, 629–642. https://doi.org/10.1007/s10803-012-1604-y

Hodgetts, S., Nicholas, D., Zwaigenbaum, L., & McConnell, D. (2013). Parents' and professionals' perceptions of family-centered care for children with autism spectrum disorder across service sectors. *Social Science and Medicine*, *96*, 138–146. https://doi.org/10.1016/j.socscimed.2013.07.012

Jellett, R., Wood, C. E., Giallo, R., & Seymour, M. (2015). Family functioning and behaviour problems in children with autism spectrum disorders: The mediating role of parent mental health. *Clinical Psychologist*, *19*, 39–48. https://doi.org/10.1111/cp.12047

Khanna, R., Madhavan, S. S., Smith, M. J., Tworek, C., Patrick, J. H., & Becker-Cottrill, B. (2012). Psychometric properties of the Caregiver Strain Questionnaire (CGSQ) among caregivers of children with autism. *Autism*, *16*, 179–199. https://doi.org/10.1177/1362361311406143

Kientz, M. A., & Dunn, W. (1997). A comparison of the performance of children with and without autism on the Sensory Profile. *American Journal of Occupational Therapy*, *51*, 530–537. https://doi.org/10.5014/ajot.51.7.530

Kirby, A. V., Little, L. M., Schultz, B., & Baranek, G. T. (2015). Observational characterization of sensory interests, repetitions, and seeking behaviors. *American Journal of Occupational Therapy*, *69*, 6903220010. https://doi.org/10.5014/ajot.2015.015081

Kirby, A. V., White, T. J., & Baranek, G. T. (2015). Caregiver strain and sensory features in children with autism spectrum disorder and other developmental disabilities. *American Journal on Intellectual and Developmental Disabilities*, *120*, 32–45. https://doi.org/10.1352/1944-7558-120.1.32

Kogan, M. D., Strickland, B. B., Blumberg, S. J., Singh, G. K., Perrin, J. M., & van Dyck, P. C. (2008). A national profile of the health care experiences and family impact of autism spectrum disorder among children in the United States, 2005–2006. *Pediatrics*, *122*, e1149–e1158. https://doi.org/10.1542/peds.2008-1057

Kuhaneck, H. M., Madonna, S., Novak, A., & Pearson, E. (2015). Effectiveness of interventions for children with autism spectrum disorder and their parents: A systematic review of family outcomes. *American Journal of Occupational Therapy*, *69*, 6905180040. https://doi.org/10.5014/ajot.2015.017855

Lam, S. F., Wong, B. P. H., Leung, D., Ho, D., & Au-Yeung, P. (2010). How parents perceive and feel about participation in community activities: The comparison between parents of preschoolers with and without autism spectrum disorders. *Autism*, *14*, 359–377. https://doi.org/10.1177/1362361309346558

LaVesser, P., & Berg, C. (2010). Participation patterns in preschool children with an autism spectrum disorder. *OTJR: Occupation, Participation and Health*, *31*, 33–39. https://doi.org/10.3928/15394492-20100823-01

LeCouteur, A., Lord, C., & Rutter, M. (2003). *Autism Diagnostic Interview–Revised*. Los Angeles: Western Psychological Services.

Little, L. M., Ausderau, K., Sideris, J., & Baranek, G. T. (2015). Activity participation and sensory features among children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *45*, 2981–2990. https://doi.org/10.1007/s10803-015-2460-3

Little, L. M., Freuler, A. C., Houser, M. B., Guckian, L., Carbine, K., David, F. J., & Baranek, G. T. (2011). Psychometric validation of the Sensory Experiences Questionnaire. *American Journal of Occupational Therapy*, *65*, 207–210. https://doi.org/10.5014/ajot.2011.000844

Little, L. M., Sideris, J., Ausderau, K., & Baranek, G. T. (2014). Activity participation among children with autism spectrum disorder. *American Journal of Occupational Therapy*, *68*, 177–185. https://doi.org/10.5014/ajot.2014.009894

Lord, C., Rutter, M., DiLavore, P. C., & Risi, S. (1999). *Autism Diagnostic Observation Schedule*. Los Angeles: Western Psychological Services.

Mactavish, J. B., & Schleien, S. J. (2004). Re-injecting spontaneity and balance in family life: Parents' perspectives on recreation in families that include children with developmental disability. *Journal of Intellectual Disability Research*, *48*, 123–141. https://doi.org/10.1111/j.1365-2788.2004.00502.x

Marquenie, K., Rodger, S., Mangohig, K., & Cronin, A. (2011). Dinnertime and bedtime routines and rituals in families with a young child with an autism spectrum disorder. *Australian Occupational Therapy Journal*, *58*, 145–154. https://doi.org/10.1111/j.1440-1630.2010.00896.x

McCormick, C., Hepburn, S., Young, G. S., & Rogers, S. J. (2015). Sensory symptoms in children with autism spectrum disorder, other developmental disorders and typical development: A longitudinal study. *Autism*, *20*, 572–579. https://doi.org/10.1177/1362361315599755

Mullen, E. M. (1995). *Mullen Scales of Early Learning* (AGS ed.). Los Angeles: Western Psychological Services.

Patten, E., Baranek, G. T., Watson, L. R., & Schultz, B. (2013). Child and family characteristics influencing intervention choices in autism spectrum disorders. *Focus on Autism and Developmental Disabilities*, *28*, 138–146. https://doi.org/10.1177/1088357612468028

Phelps, K. W., McCammon, S. L., Wuensch, K. L., & Golden, J. A. (2009). Enrichment, stress, and growth from parenting an individual with an autism spectrum disorder. *Journal of Intellectual and Developmental Disability*, *34*, 133–141. https://doi.org/10.1080/13668250902845236

Plant, K. M., & Sanders, M. R. (2007). Predictors of care-giver stress in families of preschool-aged children with developmental disabilities. *Journal of Intellectual Disability Research*, *51*, 109–124. https://doi.org/10.1111/j.1365-2788.2006.00829.x

Rao, P. A., & Beidel, D. C. (2009). The impact of children with high-functioning autism on parental stress, sibling adjustment, and family functioning. *Behavior Modification*, *33*, 437–451. https://doi.org/10.1177/0145445509336427

Reynolds, S., Bendixen, R. M., Lawrence, T., & Lane, S. J. (2011). A pilot study examining activity participation, sensory responsiveness, and competence in children with high functioning autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *41*, 1496–1506. https://doi.org/10.1007/s10803-010-1173-x

Roid, G. H. (2003). *Stanford–Binet Intelligence Scales* (5th ed.). Rolling Meadows, IL: Riverside.

Schaaf, R. C., Toth-Cohen, S., Johnson, S. L., Outten, G., & Benevides, T. W. (2011). The everyday routines of families of children with autism: Examining the impact of sensory processing difficulties on the family. *Autism*, *15*, 373–389. https://doi.org/10.1177/1362361310386505

Schopler, E., Reichler, R. J., & Renner, B. R. (1988). *The Childhood Autism Rating Scale*. Los Angeles: Western Psychological Services.

Van Naarden Braun, K., Yeargin-Allsopp, M., & Lollar, D. (2006). A multi-dimensional approach to the transition of children with developmental disabilities into young adulthood: The acquisition of adult social roles. *Disability and Rehabilitation*, *28*, 915–928. https://doi.org/10.1080/09638280500304919

Watson, L. R., Patten, E., Baranek, G. T., Poe, M., Boyd, B. A., Freuler, A., & Lorenzi, J. (2011). Differential associations between sensory response patterns and language, social, and communication measures in children with autism or other developmental disabilities. *Journal of Speech, Language, and Hearing Research*, *54*, 1562–1576. https://doi.org/10.1044/1092-4388(2011/10-0029)

Anne V. Kirby, PhD, OTR/L, is Assistant Professor, Department of Occupational and Recreational Therapies, University of Utah, Salt Lake City; avkirby@gmail.com

Kathryn L. Williams, MS, OTR/L, is Doctoral Candidate, Division of Occupational Science and Occupational Therapy, University of North Carolina at Chapel Hill.

Linda R. Watson, EdD, CCC-SLP, is Professor, Division of Speech and Hearing Sciences, University of North Carolina at Chapel Hill.

John Sideris, PhD, is Professor of Research, Mrs. T. H. Chan Division of Occupational Science and Occupational Therapy, University of Southern California, Los Angeles. At the time of this study, he was Scientist, Frank Porter Graham Child Development Institute, University of North Carolina at Chapel Hill.

John Bulluck, BA, was Research Systems Analyst, Department of Allied Health Sciences, University of North Carolina at Chapel Hill, at the time of this study.

Grace T. Baranek, PhD, OTR/L, FAOTA, is Associate Dean, Chair, and Mrs. T. H. Chan Professor of Occupational Science and Occupational Therapy, Mrs. T. H. Chan Division of Occupational Science and Occupational Therapy, University of Southern California, Los Angeles. At the time of this study, she was Professor and Associate Chair for Research, Department of Allied Health Sciences, University of North Carolina at Chapel Hill.

Acknowledgments

This research was supported by a grant from the National Institute for Child Health and Human Development (NICHD; Grant R01-HD42168). Recruitment was assisted by the Research Participant Registries at the Carolina Institute for Developmental Disabilities (supported by NICHD Grant U54HD079124-02).

Citation: Kirby, A. V., Williams, K. L., Watson, L. R., Sideris, J., Bulluck, J., & Baranek, G. T. (2019). Sensory features and family functioning in families of children with autism and developmental disabilities: Longitudinal associations. *American Journal of Occupational Therapy, 73,* 7302205040. https://doi.org/10.5014/ajot.2018.027391