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Associations of Physiological Factors, Age, and Sensory Over-Responsivity with Food Selectivity in Children with Autism Spectrum Disorders

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Associations of Physiological Factors, Age, and Sensory Over-Responsivity with Food Selectivity in Children with Autism Spectrum Disorders

Abstract
PURPOSE: The aim of this study was to investigate the relationship among physiological factors, age, sensory over-responsivity (SOR) and food selectivity in children with autism spectrum disorders (ASD).

METHODS: One hundred forty-one parents of children with ASD were recruited through a national autism organization, Autism Speaks, to fill out a survey regarding their child's mealtime behavior. Survey contained items to measure the severity of food selectivity behavior, the presence of physiological factors (i.e., reflux, constipation, food allergies and the need for a specialized diet) and sensory over-responsivity (SOR). Results were analyzed using Chi Square, ANOVA and logistic regression.

RESULTS: No relationship between physiological factors and level of food selectivity was found. Older children in the 3-9 year old range did not have more foods in their diet repertoire than younger children. Finally, children with fewer than 10 and those with 11-20 foods in their diet (i.e., severe food selectivity and moderate food selectivity respectively) were found to have significantly higher scores on a measure of SOR when compared to children with 21+ foods (typical selectivity).

CONCLUSIONS: When addressing food selectivity in children with ASD, consideration of the possibility that the child may not outgrow restricted diets is warranted. Also, treatment for food selectivity may be more effective if SOR is included in protocol.

Keywords
food selectivity, autism, sensory over-responsivity

Cover Page Footnote
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Children with Autism Spectrum Disorders (ASD), by definition, exhibit dysfunction in social interaction and communication, and have behavior that is restricted, repetitive or stereotyped (American Psychological Association, 2000). Parents of children with ASD face many challenges in their daily activities, including coping with challenging aspects of their children's mealtime behavior (e.g., Bruns & Thompson, 2011). This includes children who demonstrate food selectivity, estimated at 40-60% of children with ASD (Cornish, 1998; Schreck & Williams, 2006). Food selectivity has been defined as having a restricted repertoire of accepted foods (Bandini et al., 2010). Clinicians and parents describe children with ASD and accompanying food selectivity as only eating foods of a particular texture, color or flavor, off of a particular plate and/or with certain utensils (Schreck & Williams, 2006). A critical review of research on food selectivity among children with ASD led Matson and Fodstad (2009) to conclude that feeding problems in children with ASD are frequent, under-recognized and in need of further research.

Food selectivity can have a variety of consequences for children with ASD and their families. For example, food selectivity has been associated with inadequate nutrition (Cornish, 1998; Dovey, Staples, Gibson, & Halford, 2008; Herndon, DiGuiseppi, Johnson, Leiferman, & Reynolds, 2009). In fact, for children with ASD, food selectivity, with accompanying concern about dietary intake, is a primary reason for referral to dietary services (Bowers, 2002). Social concerns exist as well. If mealtime is a battle between parent and child, this has the potential to impact the family's overall quality of life (Fulkerson, Story, Neumark-Sztainer, & Rydell, 2008).

Although food selectivity is a prominent problem for many families with children with ASD, it is not universal in the ASD population (Ahern, Castine, Nault, & Green, 2001). Differences associated with whether or not children with ASD exhibit food selectivity are just

beginning to be explored. Investigations of such factors may shed light on the nature of the problem and have implications for treatment approaches (Matson & Fodstad, 2009). The literature suggests that factors related to food selectivity include physiological dysfunction (i.e., reflux, constipation, food allergy or the need for a specialized diet), age of the child and sensory over-responsivity.

Possible factors that may be associated with food selectivity in children with ASD are frequent illness or physical discomfort associated with reflux, constipation or food sensitivity. Prior research suggests that children with ASD may experience more gastrointestinal problems, including gastrointestinal reflux and constipation, when compared to typically developing peers (e.g., Horvath, Papadimitriou, Rabsztyn, Drachenberg, & Tildon, 1999; Matson & Fodstad, 2009). As a consequence, discomfort associated with this abnormality could contribute to feeding dysfunction (Douglas & Bryon, 1996). If any of these conditions is present, it could lead to decreased interest in food accompanied by protective behavior to avoid discomfort associated with eating (Horvath et al., 1999).

The age of the child with autism also may be related to the presence of food selectivity. Many parents of typically developing toddlers describe their young children as “picky” or resistive to trying anything new (Bandini et al., 2010). A review of the literature regarding typically developing children reveals that a reluctance to try new foods increases and peaks between ages 2 and 6 years, then falls away for most children after the preschool years (Dovey et al., 2008). It is unclear in the literature, however, whether children with autism follow this pattern by adding new foods to their restricted diets or if their period of food selectivity extends beyond age 6.

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Sensory over-responsivity (SOR) also has been proposed as a factor that may contribute to food selectivity in the ASD population (Cermak, Curtin, & Bandini, 2010). SOR is defined as a faster, more intense, and longer lasting response to sensation, inconsistent with the demands of the environment (Miller, Anzalone, Lane, Cermak, & Osten, 2007). Some support for the proposed link between SOR and food selectivity was found in existing literature. For example, Smith, Roux, Naidoo, and Venter (2005) found that typically developing children who identified with tactile defensiveness on Dunn's (1999) Sensory Profile ate fewer fruits and vegetables and were more likely to gag on food than children without tactile defensiveness. Johnson and Harris (2004) also found a correlation between food refusal and tactile hypersensitivity in typically developing infants. Other research has shown that children on the autism spectrum have more tactile and taste/smell sensitivities than children with other developmental disabilities and sensory scores are correlated with stereotyped interests and behaviors (Wiggins, Robins, Bakeman, & Adamson, 2009). SOR, and in particular tactile over-responsivity, in some children with ASD could be a factor that contributes to food selectivity.

The identification of differences between the selective and not selective children in the ASD population could allow for early identification of children at risk so that early intervention could be tailored to the child's and the family's needs. The current study examined factors associated with levels of food selectivity based on how many foods the parents reported a particular child with ASD ate as part of his/her regular diet. Research questions included: (1) Do children with ASD with different levels of food selectivity demonstrate differences in parental report of reflux, constipation, food allergy or need for a specialized diet? (2) Are levels of food selectivity associated with the age of the child? (3) Is severe food selectivity level associated

with a child's score on a parent-report measure of sensory over-responsivity (SOR)? (4) What SOR items best predict levels of food selectivity?

Methods

This descriptive study was conducted with an electronic survey designed to collect information from parents of children with ASD about their perceptions of their child's food acceptance behavior. No reference was made to feeding or food selectivity in the recruitment material. The general title "Exploring Health and Behavior Issues Parenting a Child with Autism" was used to reduce the likelihood of a biased sample reflecting only respondents whose child was demonstrating food selectivity problems. The sample was obtained through the Interactive Autism Network (IAN) Project at the Kennedy Krieger Institute, Baltimore, Maryland. The platform used for collecting data was SurveyMonkey™. Autism Speaks, as part of its mission, connects parents of children with ASD to researchers. The Human Subjects Institutional Review Board at Western Michigan University also approved the study protocol.

Participants

The goal was to recruit a broad sample of parents of children with ASD in the 3-9 year old age range. The IAN emailed 1,985 letters randomly to parents in its database, inviting them to participate in the study. Parents of children with an ASD diagnosis were invited to follow a link to a consent form, which indicated that, if they agreed to participate, they should follow the link to the on-line survey. Their continuation served as consent. Parents were assured of anonymity, but they were given the option to provide contact information if they would be willing to consider completing a follow-up survey. They were also told that they would have the option to exit at any point if they chose.

Instrumentation

The survey contained 72 items, including a question about the source of the child's autism diagnosis (e.g., pediatrician, school system, psychologist), questions about the age of the child, the child's food preferences and physiological factors and used a 19 item scale to measure SOR based on two sources (Dunn, 1999; Miller, 2006). Items related to food (n=3) and physiological factors (n=4) included the following questions: "How many foods does your child easily accept as part of his/her regular diet?" (choices included fewer than 5 foods, 6-10 foods, 11-20 foods, 21-30 foods, 31+ foods); "Does your child refuse food based on texture?" (yes or no); "Does your child have a diagnosis of reflux?" (yes or no); and "Does your child have food allergies?" (yes or no).

SOR was a primary variable of interest in this study, based on the hypothesis that children who are hypersensitive to sensory input might be more likely to have highly restricted food preferences. Although Schoen, Miller and Green (2008) described a clinical observation scale to diagnose SOR as under development, at the time the survey was being designed (April 2010) no scale was available for the specific purpose of measuring SOR alone. Therefore, a SOR scale was designed by referencing questions from two clinically respected sources that discuss or measure sensory processing disorders (Dunn, 1999; Miller, 2006). The Short Sensory Profile (Dunn, 1999) contains items related to SOR including items that measure tactile sensitivity, taste/smell sensitivity, movement sensitivity and visual auditory sensitivity. However, the total score includes items related to sub-categories of sensory modulation disorder other than SOR. Therefore, Short Sensory Profile items in SOR relevant categories were cross referenced or combined with "Red Flags of Sensory Over-Responsivity" (Miller, 2006, p. 24) based on the author's clinical experience. Development of this SOR scale included additional

expert panel review by two occupational therapists who were knowledgeable about sensory processing deficits and who were recruited by the researcher for this purpose. The scale was a Likert-scale parent questionnaire, which yielded a score ranging from 19, indicating no behaviors associated with SOR (i.e., scored all 1's indicating "never exhibit behavior"), to 95, the highest level of dysfunction (i.e., "always exhibit behavior"). The scale included items linked to the tactile system and items linked to other sensory systems (e.g., visual, vestibular). (See appendix A.)

Data Analysis

Operationalization of food selectivity and physiological factors were as follows. Food selectivity was categorized into three levels based on the objective evidence in a study by Cornish (1998) that addressed the degree of nutritional deficit resulting from food selectivity. In the Cornish study, children who accepted fewer than 8 foods were considered to be at risk for severe nutritional concerns; whereas moderate nutritional concerns were associated with acceptance of 8-20 foods. In the current study, parents were presented with choices in blocks of 10. Thus, parents were given the choice of 10 or fewer foods, rather than the 8 or fewer foods suggested by Cornish, to remain consistent with other categories (i.e., 11-20 and >21) and thought to be easier for parents to estimate. This resulted in severe food selectivity to be operationalized as acceptance of 10 or fewer different foods; moderate food selectivity was defined as acceptance of 11-20 different foods; and typical selectivity was defined as acceptance of 21 or more different foods as part of a child's regular diet. Food selectivity also was divided a second time into "severe" and "not severe" for the purpose of determining if severe food selectivity could be predicted from SOR scores. Physiological dysfunction factors (i.e., reflux,

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constipation, food allergies and the need for a specialized diet) were operationalized as absent or present.

Statistical analysis included chi-square (Fisher's exact tests when cells sizes were small) to examine relationships between physiological factors and food selectivity. One-way analysis of variance (ANOVA) and Bonferroni post hoc testing (when a significant difference existed) were used to explore age and SOR by food selectivity group. Binary logistic regression was used to test associations of membership in the severe food selectivity category with age in months and with particular SOR scale items.

Results

The survey was completed by 141 parents during the eight month period from September 2010 to April 2011. Using the figure of 1,985 emails of invitation mailed by the Autism Speaks website administrator to members of the research network, this yielded a survey response rate of 7%. In this sample, 95% of the children with ASD were male compared to 87% in the population (Whiteley, Todd, Carr, & Shattock, 2010). Forty-nine percent of the parents who responded had more than four years of college education, and 92% of respondents were Caucasian. Of the 141 parent respondents, 19% reported that their child ate fewer than 10 foods as part of their regular diet; 26% reported that their child ate 11-20 foods; and 55% reported that their child ate more than 21 foods (see Figure 1). The ages of the children in the severe food selectivity level ranged from 41-107 months, with a mean of 74.7 months and a standard deviation of 22.2. The ages of the children in the moderate food selectivity level ranged from 36-106 months with a mean of 74.9 months and a standard deviation of 16.7. Finally, the ages of the children in the typical food selectivity level ranged from 42-107 months with a mean of 82.6 months and a standard deviation of 18.2.

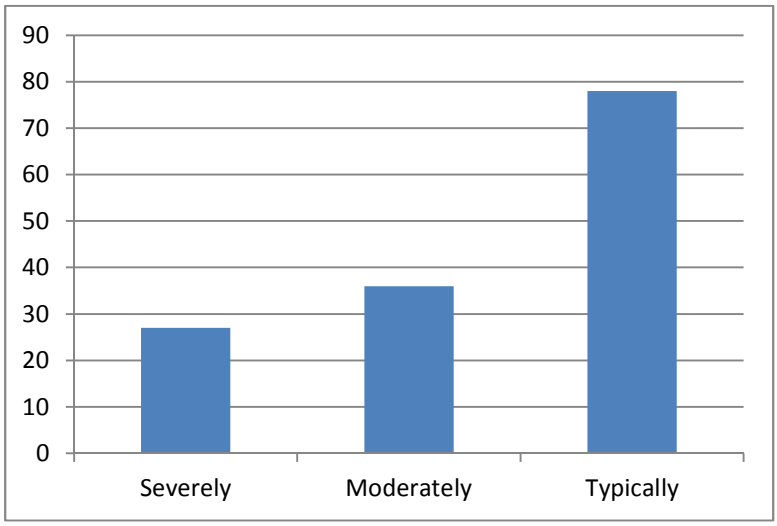

Figure I. Frequency of membership in food selectivity level.

The first research question asked whether there was a relationship between food selectivity and the physiological factors of food allergies and the need for a specialized diet. Chi-square tests showed that there was no association between these two factors. Fisher's exact test was used to test the relationship between the level of food selectivity and the reflux and constipation variables due to cell sizes less than five. Again, there was no relationship between the level of food selectivity and reflux and constipation. Table 1 summarizes these results.

Table 1

Relationship Between Food Selectivity Level and Physiological Factors

	χ^2 /Fisher's	*p*
Food Allergies	.81	.77
Need for a Specialized Diet	.80	.67
Reflux	3.34	.19
Constipation	1.10	.58

Note. 2 degrees of freedom for each.

The second research question asked about the relationship between the age of the child and the degree of food selectivity. Table 2 contains the mean ages (and standard deviations) for the severely, moderately and typically selective groups. Using ANOVA, there was not a significant difference between the ages in months in the three groups, F (2, 135) =2.94, p=.08.

Table 2

Summary of Means, Standard Deviations and Confidence Intervals for Age and SOR Scores at Each Level of Food Selectivity

	Severe Food Selectivity (n=26)	Moderate Food Selectivity (n=34)	Typical Food Selectivity (n=70)
	X (SD) [95% CI]	X (SD) [95% CI]	X (SD) [95% CI]
Age (years)	6.23 (1.85) [5.46, 6.99]	6.24 (1.39) [5.77, 6.71]	6.88(1.51) [6.53, 7.23]
SOR Score	57.85 (15.85) [51.58, 64.12]	50.06(12.05) [45.98, 54.13]	43.32(13.59) [39.19,45.45]

Note. CI = confidence interval. SOR = Sensory Over-Responsivity. Higher SOR scores indicate higher levels of over-responsivity.

The third research question asked about associations between SOR and food selectivity in children with ASD. Table 2 provides the means and standard deviations for the three food selectivity groups, with higher scores indicative of greater SOR. SOR scores of the severe, moderate and typically selective children were compared using ANOVA, and, in this case, there was a significant difference between the three groups, F (2, 137) =13.72, p<.0001, r=.41. Children who were more selective in the number of foods that they would eat had higher SOR

scores, indicating higher levels of SOR. Bonferroni post hoc testing revealed no significant difference between severe and moderate groups (p=.081); however, there were significant differences between SOR scores for groups with severe and typical selectivity (p<.0001) and for groups with moderate and typical selectivity (p=.018).

Table 3

Logistic Regression Analyses Predicting Membership in Severe Food Selectivity Group by Tactile and Other SOR Items

	Unadjusted		Adjusted	
	OR	*P*	OR	*P*
Tactile SOR*	3.10	< .001	2.66	.004
Other SOR*	4.26	.004	1.77	.346

Note. OR= Odds Ratio
*results shown for 10 point increase in score

Further analysis to explore the SOR items that best predicted membership in the severe food selectivity category was conducted using binary logistic regression. Results are displayed in Table 3. For this analysis, SOR scale items were divided into two groups: tactile and other. These groups were chosen based on the literature described above that showed a relationship between tactile defensiveness and feeding dysfunction (Johnson & Harris, 2004; Smith et al., 2005). Based on the hypotheses that drove this study, the items that reflected behaviors associated with dysfunction in the tactile system were compared to items related to the other senses (i.e., auditory, vestibular, visual). When the tactile items and other sensory items were

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placed in the logistic regression model separately, each was found to be associated significantly with membership in the severe food selectivity category. When "other" sensory items were put in the model with the tactile items, only the tactile items were associated with membership in the severe group.

Discussion

In summary, the purpose of this study was to examine the relationship among food selectivity and physiological factors, the age of the child and SOR. Reflux, constipation, food allergies and the need for a specialized diet were not associated with food selectivity levels for children with ASD on this parent report survey. Age also was not related to the number of foods parents reported their child accepts. Among the three sets of hypothesized related factors, only SOR scores were associated with reported levels of food selectivity. Specifically, children in the severe and moderate food selectivity group had significantly higher scores on the SOR scale than children accepting more than 20 foods (defined as typical for purposes of this study). Severe food selectivity categorization could be predicted significantly when tactile SOR items were used in the logistic regression model. Specifically, for every 10 point increase on the tactile SOR scale, children were 2.66 times more likely to fall into severe food selectivity category.

It is important to note that this parent survey study was purposefully not identified to prospective participants as a survey related to food selectivity. This choice was made in order to obtain a sample that contained both children with and without food selectivity in the autism population. In spite of this effort to reach a broader group of parents of children with ASD, 45% of parents who responded reported that their child with ASD accepted fewer than 20 foods as part of their regular diet. This figure can be compared to the results reported by Cornish (1998), who, using a three day dietary recall completed by parents, found that 59% of children with ASD

(n=17) ate fewer than 20 different foods. A less precise comparison can be made with a study by Schreck and Williams (2006), who found that 72% of parents reported that their child with ASD had a "restricted variety" of foods accepted, and with a study by Williams and colleagues (2005) who found that 60% of parents reported their child "ate few foods." The development of a standard definition of food selectivity would allow for better comparisons to be made across the autism population (Bandini et al., 2010). Through a consistent definition and a greater understanding of the factors associated with food selectivity, as well as the consequences of this dysfunction, an effective treatment could be developed.

Another factor that has been suggested in the literature in association with food selectivity is the age of the child (Dovey et al., 2008). Specifically, Dovey et al., indicated that children ages 2-6 in the general population may experience food neophobia and a reluctance to try new foods. The range of children's ages in this study was 3-9 years by study selection criteria, which incorporates most of this range but extends beyond it. ANOVA did not reveal statistically significant differences between the ages of the children in the three food selectivity groups despite the inclusion of children up to age 9. This adds to a growing body of evidence that age may not be a major factor in food selectivity in children with ASD (Bandini et al., 2010). Nevertheless, longitudinal research following individual children over time, as well as research on adolescent and adult children with ASD, is needed for a better understanding of this relationship.

This study provides preliminary support for the association between food selectivity and SOR, particularly tactile over-responsivity. In particular, the post hoc analyses for this study showed that children whose parents reported that they ate fewer than 20 foods as part of their regular diet had significantly higher scores on the SOR measure than groups eating more than 20

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foods. This suggests that there may be more than face validity for the somewhat arbitrary choice of 20 as the cut point between moderate food selectivity and no food selectivity. These findings need to be replicated, however, in order to establish firmly the association between SOR and food selectivity and the validity of varied cut points for different purposes, including nutritional concerns, as suggested by Cornish (1998).

Several limitations must be noted when interpreting the results. First, the response rate of 7% was low (i.e., 141 respondents out of 1,985 emails sent). Second, participants were members of a research network hosted by a national website. They were mostly well-educated Caucasian parents and may not be representative of families of the full population of children with autism, which extends across race/ethnicity groups and levels of socioeconomic status (National Institute of Child Health and Development, 2005). Another limitation is that, because this was a parent report measure, the child's diagnosis as having ASD was not independently verified, and parents provided a subjective report of their child's behavior. This subjective report included the parent's tabulation of how many foods their child eats as part of his/her regular diet. This tabulation may have varied from parent to parent. Finally, the SOR scale used in this study was developed by the researcher. Although the measure was compiled using multiple source review and expert panel input, it has not been formally tested for validity and reliability.

On the other hand, this study provides valuable insight into the food selectivity problem that can be used to gain generalizable information through recruitment of a more fully representative group in future studies. Strengths of the study include that it investigated several possible factors in association with food selectivity, and that parents of children with ASD with and without food selectivity responded.

Implications for further research include examining the impact of food selectivity on family quality of life and investigating the nutritional status of children with severe food selectivity. This was a cross-sectional study and there is a need to follow particular children over time to fully understand the progression of food selectivity in individual children. Further exploration of the operational definition of food selectivity as acceptance of fewer than 20 foods, with severe food selectivity being acceptance of fewer than 10 foods, is also warranted. Identification of the most effective intervention approaches for treating food selectivity in the ASD population is needed as well.

Conclusions

According to parental report regarding their child with ASD, physiological factors (i.e., reflux, constipation, food allergies and the need for a specialized diet) examined were not related to the child's level of food selectivity. Also, food selectivity among children with ASD in this study in the 3-9 year old range was not associated significantly with a child's age. Therefore, based on this study, an assumption that the number of foods accepted will increase with age is not supported for those ages 3 to 9 years. Children whose parents reported that they accepted fewer than 20 foods in their diet had significantly higher scores on a SOR measure than children accepting more than 20 foods. This study provides preliminary support for the association between food selectivity and SOR, particularly tactile items. The results suggest that sensory processing should be considered when designing treatment for children with ASD and food selectivity.

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References

Ahearn, W. H., Castine, T., Nault, K. & Green, G. (2001). An assessment of food acceptance in children with autism or pervasive developmental disorder-not otherwise specified. *Journal of Autism and Developmental Disorders, 31,* 505-511.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders (4th ed.,text revision).* Washington, DC: American Psychiatric Association.

Bandini, L. G., Anderson, S. E., Curtin, C., Cermak, S., Evans, E. W., Scampini, R., Maslin, M., & Must, A. (2010). Food selectivity in children with autism spectrum disorders and typically developing children. *The Journal of Pediatrics, 157* (2), 259-264.

Bowers, L. (2002). An audit of referrals of children with autistic spectrum disorder to the dietetic service. *Journal of Human Nutrition and Dietetics,15* (2), 141-144.

Bruns, D. & Thompson, S. (2011). Time to eat: Improving mealtimes of young children with autism. *Young Exceptional Children, 14* (3), 3-18.

Cermak, S. A., Curtin, C. & Bandini, L. G. (2010). Food selectivity and sensory sensitivity in children with autism spectrum disorders. *Journal of the American Dietetic Association, 110* (2), 238-246.

Cornish, E. (1998). A balanced approach towards healthy eating in autism. *Journal of Human Nutrition and Dietetics,11*, 501-509.

Douglas, J. E., & Bryon, M. (1996). Interview data on severe behavioural eating difficulties in young children. *Archives of Disease in Childhood, 75,* 304-308.

Dovey, T. M., Staples, P. A., Gibson, E. L., & Halford, J. C. G. (2008). Food neophobia and 'picky/fussy' eating in children: A review. *Appetite 50*, 181-193.

Dunn, W. (1999). *The Sensory Profile: User's Manual.* San Antonio, TX: The Psychological Corporation.

Fulkerson, J. A., Story, M., Neumark-Sztainer, D., & Rydell, S. (2008). Family meals: perceptions of benefits and challenges among parents of 8-10 year old children. *Journal of the American Dietetic Association, 108* (4), 706-709.

Herndon, A. C., DiGuiseppi, C., Johnson, S. L., Leiferman, J., & Reynolds, A. (2009). Does nutritional intake differ between children with autism spectrum disorders and children with typical development? *Journal of Autism and Developmental Disord*ers, *39,* 212-222.

Horvath, K., Papadimitriou, J., Rabsztyn, A., Drachenberg, C., & Tildon, J. T. (1999). Gastrointestinal abnormalities in children with autistic disorder. *Journal of Pediatrics, 135,* 559-563.

Johnson, R., & Harris, G. (2004). A preliminary study of the predictors of feeding problems in late infancy. *Journal of reproductive and infant psychology, 22* (3), 183-188.

Matson, J. L., & Fodstad, J.C. (2009). The treatment of food selectivity and other feeding problems in children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 3*, 455-461.

Miller, L. J. (2006). Sensational Kids. New York, NY: G. P. Penguin Group.

Miller, L. J., Anzalone, M. E., Lane, S. J., Cermak, S.A., & Osten, E. T. (2007). Concept evolution in sensory integration: A proposed nosology for diagnosis. *American Journal of Occupational Therapy, 61* (2), 135-140.

National Institute of Child Health and Human Development. (2005). Autism Overview: What we Know. *Retrieved from http://www.nichd.nih.gov/publications/pubs/upload/introduction_autism.pdf.*

DOI: 10.15453/2168-6408.1004

Schoen, S. A., Miller, L. J., & Green, K. E. (2008). Pilot study of the Sensory Over-Responsivity Scales: Assessment and inventory. *American Journal of Occupational Therapy, 62,* 393–406.

Schreck, K. A., & Williams, K. (2006). Food preferences and factors influencing food selectivity for children with autism spectrum disorders. *Research in Developmental Disabilities, 27*, 353-363.

Smith, A., Roux, S., Naidoo, N. T., & Venter, D. J. L. (2005). Food choices of tactile defensive children. *Nutrition, 21,* 14-19.

Whiteley, P., Todd, L., Carr, K., & Shattock, P. (2010). Gender Ratios in Autism, Asperger syndrome and autism spectrum disorder. *Autism Insights, 2,* 17-24.

Wiggins, L. D., Robins, D. L., Bakeman, R., & Adamson, L. B. (2009). Brief report: Sensory Abnormalities as Distinguishing Symptoms of Autism Spectrum Disorders in Young Children. *Journal of Autism and Developmental Disorders, 39* (7), 1087-1091.

Williams, K. E., Gibbons, B. G., & Schreck, K. A. (2005). Comparing selective eaters with and without developmental disabilities. *Journal of Developmental and Physical Disabilities, 17*, 299-309.

Appendix A: SOR Scale

Please answer some questions about your child's response to sensory information. Use the following key to choose your answers:

Always (100% of the time) = Your child always responds this way to this situation.

Often (75% of the time) = Your child frequently responds this way to this situation.

Sometimes (50% or the time) = Your child sometimes responds this way to this situation.

Seldom (25% of the time) = Your child seldom responds this way to this situation.

Never (0% of the time) = Your child never responds this way to this situation.

		Never	Seldom	Sometimes	Often	Always
1	My child dislikes having messy or sticky hands (sand, glue, paint on his/her hands).					
2	My child will not walk barefoot outside.					
3	My child dislikes the feeling of crumbs or food around his/her mouth.					
4	My child gets upset when having his/her hair, fingernails or toe nails cut, and/or getting face washed.					
5	My child resists tooth brushing.					
6	My child is sensitive to certain textures of clothing or bed sheets on his/her skin.					

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7	My child reacts negatively to touch (gets upset or emotional when touched).					
8	My child has difficulty being physically close to others (e.g., standing in line).					
9	My child rubs or scratches a spot on his/her body after it is touched.					
10	My child needs his/her socks and shoes to be "just right" and often becomes annoyed putting them on.					
11	My child gags with things like utensils or food touching his/her mouth.					
12	My child is easily upset by smells that others don't notice.					
13	My child is very careful and often is fearful of trying new things.					
14	My child has difficulty accepting changes in routine and transitions are hard.					
15	My child gets upset with unexpected sounds, such as emergency sirens or school bells.					
16	My child prefers not to engage in movement activities like slides or climbing on the playground.					
17	My child is bothered by bright light, like when going from inside to outside on a sunny day.					

18	My child prefers not to go to places like restaurants, stadiums or shopping centers because he/she dislikes crowds.					
19	My child winces and/or covers his/her ears with hands with loud sounds.					

(Based on prior work by Dunn, 1999; Miller, 2006).

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