Mealtime Behaviors Associated with Consumption of Unfamiliar Foods

by Young Children with Autism Spectrum Disorder

BY

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Abstract

Background: Children with autism spectrum disorder (ASD) show greater food refusal than their typically developing peers. The current study examined parent and child mealtime behaviors associated with consumption of unfamiliar foods by children with ASD.

Methods: Families of 38 children aged 2 through 8 years old and diagnosed with ASD videotaped a typical home mealtime during which parents presented the child with an unfamiliar food and mealtime behaviors were subsequently coded through an observational coding system.

Results: Only sips of drink at the meal related to whether children took a bite of the unfamiliar food (z = - 2.42, p = .02). However, parent direct commands (z = 2.01, p = .04) and parents feeding the child (z = 6.69, p < .001) related to increased likelihood of subsequent bites of the unfamiliar food in the same or subsequent 10 second interval. The child playing or being away from the table (z = - 2.39, p = .02) related to lower frequencies of subsequent bites.

Conclusions: Frequency of most mealtime behaviors across the course of the meal did not differentiate between children who took a bite of the unfamiliar food and those who did not. Clinical interventions for food selectivity in children with ASD should provide parents education on effective mealtime parenting strategies (e.g., commands and feeds) and decreasing inappropriate child mealtime behaviors (e.g., not playing at the table, not being away from the meal).

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Mealtime Behaviors Associated with Consumption of Unfamiliar Foods by Young Children with Autism Spectrum Disorder

Autism Spectrum Disorder

Recent estimates have identified that 1 in every 68 children has autism spectrum disorder (ASD; Autism and Developmental Disabilities Monitoring Network Surveillance Year 2010 Principal Investigators, 2014). ASD is characterized by persistent deficits in social communication and social interaction across multiple settings and restricted patterns of behavior, interests, or activities (American Psychiatric Association, 2013). Social impairments displayed by children with ASD include deficits in social-emotional reciprocity, nonverbal communication, and developing, maintaining, and understanding relationships. Restricted and repetitive behaviors include stereotyped motor movements, inflexible adherence to routines, and fixated interests. Additionally, children with ASD may display hyper- or hypo-sensitivity to sensory stimuli or unusual interest in sensory experiences. The *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5; American Psychiatric Association, 2013) criteria for ASD represents a change from criteria in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Text Revision* (DSM-IV TR) in that separate diagnoses for autistic disorder, Asperger's disorder, and pervasive developmental disorder not otherwise specified (PDD-NOS) are no longer present. Rather, ASD is now represented by a singular diagnosis, which includes a rating of severity for social communication and restricted/repetitive behavior impairments. Research has demonstrated that most children diagnosed with an ASD in accordance with DSM-IV TR criteria meet diagnostic criteria for ASD as defined in DSM-5, although there is some concern that some children previously diagnosed with PDD-NOS may not

meet new ASD criteria (e.g., Gibbs, Aldridge, Chandler, Witzlsperger, & Smith, 2012; Huerta, Bishop, Duncan, Hus, & Lord, 2012).

Feeding Problems in Children with ASD

Children with ASD have long been known to display feeding problems and behavioral difficulties at mealtimes. In fact, feeding problems are so frequently displayed by children with ASD that they were once considered a diagnostic characteristic of autistic disorder (Kanner, 1943). Children with ASD have been found to engage in significantly more problematic mealtime behaviors than their typically developing peers (Provost, Crowe, Osbourn, McClain, & Skipper, 2010). Children with ASD are more likely to resist sitting at the dinner table, have tantrums during mealtimes, throw or dump food, and have problems with gagging. More children with ASD are also picky eaters, resist trying new foods, limit foods to only those of certain textures, and more frequently mouth nonfood items in comparison to typically developing peers (Provost et al., 2010).

Approximately 80% of young children with ASD are reported by parents to be picky eaters, and 95% of these children are reported by parents to resist trying new foods (Lockner, Crowe, & Skipper, 2008). Children with ASD may display specific eating habits such as requiring foods to be particular textures, colors, shapes, or commercial brands (Cornish, 1998). Cornish (1998) found that approximately 18% of children with ASD ate fewer than 8 different foods during a three day period, and only about 40% of the sample ate over 20 different foods during the three day period recorded. Although some picky eating and food selectivity are typical and developmentally appropriate for young children (Crist & Napier-Phillips, 2001), young children with ASD have been found to display rates of food selectivity greater than those of their typically developing peers (e.g., Provost et al., 2010). Children with ASD refuse a greater

percentage of foods offered to them than typically developing children (42% versus 19%, respectively; Bandini et al., 2010). In a comparison of 3 to 11 year old children with ASD to typically developing children, Bandini and colleagues (2010) found that children with ASD consumed only an average of 19 foods over the course of 3 days, which was significantly less than the 22.5 foods consumed by typically developing children.

Children with ASD are also more likely to eat a narrower variety of foods within particular food groups than their typically developing peers as reported by parents on food preference inventories (Schreck, Williams, & Smith, 2004). Children with ASD consumed fewer types of fruits, dairy products, vegetables, proteins, and starches than peers, and for most of these food groups, typically developing children consumed almost double the number of types of foods as children with ASD. While typically developing children were reported to eat approximately 15 of the fruits listed on a food inventory, children with ASD were reported to eat only about 8 fruits. Further, children with ASD were reported to eat approximately 4 dairy items and 4 vegetable items, while typically developing children were reported to eat approximately 8 foods from each of these category (Schreck et al., 2004).

Factors Impacting Feeding Problems in Children with ASD

Several reasons have been proposed for why children with ASD display high rates of feeding problems. One perspective is that these restricted food preferences are similar to the restricted patterns displayed by children with ASD in other spheres of life (Cornish, 1998). Other characteristics of ASD, such as deficits in social compliance, biological food intolerance, sensory impairments, perseveration, fear of novelty, and difficulty with motor skills have been suggested as reasons for the increased rate of feeding problems in this population (Cumine, Leach, & Stevenson, 2000). Children with ASD frequently display difficulty with motor skills, and oral

motor skills deficits have been associated with food refusal in children with feeding disorders, even in absence of an ASD diagnosis (Dailey, 2009). Poor motor skills such as lack of ability to balance the body (e.g., head control, ability to grasp food) or the eye-hand coordination necessary to pick up and eat food have been related to feeding difficulties in children with chronic conditions (Bandini, Ekvall, & Stallings, 2005). Children with ASD also have greater rates of gastrointestinal problems and atypical eating behaviors such as pica (Rutter, 2006), which may contribute to higher rates of feeding problems. In addition to these child factors, parent and family factors influence child feeding problems, and family food preferences have been found to be a greater predictor of child food selectivity than some child characteristics among children with ASD (Schreck & Williams, 2006).

Impact of Feeding Problems

Feeding problems are significant because food refusal and feeding problems have been related to several negative outcomes for children and their families (e.g., Bandini et al., 2010; Kodak & Piazza, 2008). Introduction of new foods has been cited by parents of children with ASD as one of the most difficult feeding problems displayed by their child (Cornish, 1998). In fact, some parents of children with ASD have reported no longer attempting to introduce new foods due to the negative reaction by their child in response to these attempts (Cornish, 1998). Qualitative analysis of maternal narrative stories on mealtime behavior problems and food selectivity in their children with ASD has also found that mealtime problems can impact children's participation in social events, mothers' perceptions of parenting, parent effort required at mealtimes, and mothers' concerns about how they will be perceived by others (Wilkinson, 2009). Feeding problems create additional stress for parents already dealing with the many demands of having a child with a developmental disability. Kodak and Piazza (2008) noted that

parents of children with feeding disorders may experience significant stress, frustration, and depression as a result of dealing with their child's feeding problem.

Additionally, food refusal and food selectivity can have a significant impact on a child's health by limiting the consumption of particular food groups, leading to poorer nutrition. In children with ASD, consuming a limited food repertoire has been associated with inadequate consumption of nutrients in comparison to estimated average requirements for nutrients such as calcium, vitamins A, C, D, and E, iron, zinc, and fiber (Bandini et al., 2010). The number of nutrients for which children with ASD do not reach the reference nutrient intake has been found to increase as food variety decreases (Cornish, 1998), and children with ASD consume inadequate amounts of more nutrients than their typically developing peers (Bandini et al., 2010). Cornish (1998) found that nearly half of children with ASD were below the reference nutrient intake level for at least one important nutrient (i.e., vitamin C or D, iron, niacin, riboflavin, calcium, or zinc). Ledford and Gast (2006) cautioned that feeding problems in children with ASD should be treated prior to the point that a child's health reaches immediate risk, citing that delayed intervention can lead to changes in growth patterns.

Mealtime Behaviors Associated with Feeding Problems

Prior research has supported an association between parent mealtime behaviors and child feeding problems or diet variety in other populations (Faith, Scanlon, Birch, Francis, & Sherry, 2004; Hendy, Williams, Camise, Eckman, & Hedemann, 2009; Hendy, Williams, Riegel, & Paul, 2010; Williams, Hendy, & Knecht, 2008). For example, Williams and colleagues (2008) examined parent feeding behaviors and eating behavior in a clinical sample of children with feeding problems, including children with and without special needs. Restricted child diet variety was associated with fewer parental attempts to increase food consumption and greater parental

permissiveness. Greater mealtime behavior problems were associated with greater parent setting of mealtime rules and greater use of non-food rewards (Williams et al., 2008). While some of these studies have included children with ASD, this population has not been the focus of this research, and children with ASD have been combined with typically developing children in these analyses (e.g., Williams et al., 2008).

In addition to parent behaviors, child mealtime behaviors have also been related to food consumption in typically developing children (e.g., Koivisto, Fellenius, & Sjoden, 1994). For example, children's compliance with taking bites following parent recommendations has a moderate positive relationship with greater energy intake, while parents offering assistance (e.g., "Do you want me to cut your meat?") has a negative moderate relationship with energy intake (Koivisto et al., 1994). Further, children with feeding problems also display greater noncompliance with parental instructions, complaining, and playing with their food at mealtimes in comparison to children without feeding difficulties (Sanders, Patel, Le Grice, & Shepherd, 1993). While this research suggests child mealtime behaviors may relate to diet variety, less research has examined this association in comparison to research examining the relation of parent behavior to mealtimes.

Feeding Interventions

Addressing children's patterns of food refusal and food selectivity is important for appropriate health and development. Given the high prevalence of feeding problems among children with ASD, strategies to address feeding problems are often incorporated into more generalized services for children with ASD targeting a number of areas of functioning or problem behaviors, such as in-home applied behavior analysis, work with paraprofessionals in the school system, consultations with pediatricians or other professionals, and general

psychotherapy or occupational therapy services for children with ASD (e.g., Case-Smith & Miller, 1999). Feeding is also often addressed as an aspect of daily living skills (e.g., Swinth, Chandler, Hanft, Jackson, & Shepherd 2004), which are often a target of therapies for children with ASD. Further, behavior management programs educate parents about behavioral modification strategies and contingencies that can be used to address self-care and tasks of daily living, including feeding (Dawson et al., 2010).

Behavioral treatment procedures such as escape-extinction techniques (e.g., non-removal of the spoon, in which a feeder does not remove the spoon with food on it from the child's face until it has been consumed) or physical guidance by providing light pressure on the child's jaw until the mouth is opened and a bite is consumed have been found effective for treating food refusal in children with ASD (e.g., Kerwin, 1999; Kodak & Piazza, 2008). However, these strategies can be time intensive, intrusive, and more appropriate for use by trained professionals than parents themselves. For example, procedures can be complex and involve combining multiple techniques (e.g., adding differential reinforcement to other behavioral techniques; Ledford & Gast, 2006) or require parents to combine or present foods in a manner not typical for family meals (e.g., simultaneous or sequential presentation). Kodak and Piazza (2008) stated that escape-extinction techniques should only be used under direct supervision of a trained professional and warn that feeding problems can worsen from improper use of these behavioral techniques.

Present Study

Less is known about easily implemented interventions or mealtime behaviors that can be used in a child's typical home setting to treat common food refusal and food selectivity. A review of intervention studies addressing feeding problems in children with ASD found no

studies examining the impact of routine parent mealtime behaviors (e.g., parent commands or physical prompts to eat) on getting children with ASD to consume non-preferred foods (Ledford & Gast, 2006).

The current project examined parent and child mealtime behaviors associated with bites of an unfamiliar food (i.e., a food the child had never been presented before to eat) by children with ASD, using direct observation of mealtime behaviors. The current study objectives have potential clinical implications for reducing food refusal and food selectivity by providing information on mealtime behaviors that parents should engage in at mealtimes and on behaviors that parents should encourage and reinforce in their children with ASD.

Hypotheses. Given there has been no prior empirical investigation of parent and child mealtime behaviors associated with consumption of new or unfamiliar foods in a sample of children with ASD, knowledge of ASD, information from clinical anecdotes, and empirical findings with typically developing children were used to develop hypotheses. The hypotheses were:

1) **Direct Parent Commands.** Direct commands by the parent for the child to eat were hypothesized to be associated with greater consumption of an unfamiliar food. This hypothesis was based on findings with typically developing children, which found greater prompts for eating were related to greater food consumption (e.g., McKenzie et al., 1991).

2) **Parent Physical Prompts and Feeds of the Child.** Physical prompts to eat (e.g., putting food on child's fork or pushing food into a pile on the child's plate) or direct feeding of the child were also hypothesized to associate with increased consumption of unfamiliar foods. These behaviors reduce the motor behaviors required of the child,

which has been identified as one factor related to food refusal in children with ASD (Lockner et al., 2008). Additionally, these prompts tend to be concrete and do not rely on social modeling or complex contingencies (e.g., non-immediate rewards for taking bites) that may be difficult for children with ASD to understand. This hypothesis was in contrast to findings with typically developing children, which did not find a relationship between physical prompts and food consumption (Williams et al., 2008).

3) **Child Mealtime Behaviors.** Children being away from the table at mealtimes and playing with food or toys during mealtimes were hypothesized to associate with fewer child bites of the unfamiliar food. These problematic mealtime behaviors are incompatible with appropriate mealtime behavior and are believed to distract children from taking bites of their food. While this hypothesis was based less on current theory of associations between child behavior and food consumption, it was included because little research has examined the association between child mealtime behaviors and food consumption.

4) **Exploratory Analyses.** In addition to examination of these hypotheses, exploratory analyses were performed to identify any additional mealtime behaviors (e.g., parental coaxes, parent talk unrelated to food, child refusals, child requests for food) related to bites of the unfamiliar food.

Methods

Participants

Families of children aged 2 through 8 years old and diagnosed with an ASD were recruited through two Midwest hospitals in the United States. Children who were currently receiving services at the hospital, who had previously received an ASD assessment, or who had

previously received medical or therapy services and completed a registry indicating interest in research were approached about the research study. Child ASD diagnosis was verified by research staff through review of the child's medical records or by parents providing a copy of paperwork from the mental health professional who made the ASD diagnosis. Inclusion criteria also included the necessity that the child's family spoke English in the home, because the coding system used to assess mealtime behaviors has only been normed with English-speaking populations. Children were excluded if the child was dependent on a gastrostomy tube for his or her complete nutrition or the child was living in foster care. Children living in foster care were excluded due to possible instability in their living situation and mealtimes. Children were not excluded for receiving prior or current services addressing feeding.

Attempts were made to recruit 99 children eligible for participation. One family was unable to be reached due to outdated contact information (i.e., phone numbers available were no longer valid). Therefore, 98 families were contacted about participation, and 46 children (46.94%) were enrolled. The most frequent reason families were not enrolled (n = 27) was that the family could not be reached or was initially presented information about the project but was not reached to follow-up on their interest in participating. Families who declined participation cited being busy (e.g., family emergencies, schedule demands; n = 14), not wanting the child to feel different from other siblings (n = 1), and concern about the video equipment being broken (n = 1) as reasons for not participating. Nine families chose to not provide a reason for declining participation. Thirty-eight children and their families (82.61% of those enrolled) completed study measures and were included in study analyses. Six families (13.04%) withdrew from the study, noting family or child emergencies/health concerns and the time demand of completing the study as reasons for withdrawal. One additional participant was excluded because the parent did not

follow the procedure for presenting the unfamiliar food by itself but instead combined it with other foods (i.e., the researcher could not identify the food and determine when bites of the food were taken). Another participant was excluded because the child's mother rated the videotaped meal as not typical. This family was given the option to record another meal but declined.

Procedures

The current project occurred as part of a larger project assessing mealtime behaviors and weight in children with ASD. Study procedures were approved by the Institutional Review Boards of all participating institutions. Children were recruited through the Developmental and Behavioral Sciences outpatient clinic at Children's Mercy Hospitals and Clinics and the Department of Pediatrics and Center for Child Health and Development at the University of Kansas Medical Center. Families were recruited through several methods. Flyers were posted in the outpatient clinic and included in packets of information received following outpatient clinic services. Additionally, children meeting study inclusion criteria were informed at outpatient clinic appointments about the research project by either a researcher or the mental health professional. At Children's Mercy Hospital, records of children who received a comprehensive assessment resulting in an ASD diagnosis were also reviewed for eligible patients, and families of these children were contacted through mailings and phone calls. Families at the University of Kansas Medical Center who previously indicated interest in research via the Research Registry and who met inclusion criteria were provided information about the study by phone. Lastly, a small number of families were approached at appointments in the Center for Child Health and Development at the University of Kansas Medical Center and provided additional information about the study.

Families who made the decision to participate provided verbal consent over the phone for a researcher to visit their home to complete written informed consent and provide them with supplies needed for study participation. Prior to the home visit, the researcher identified with parents an unfamiliar food for their child. This food was brought by the research assistant to the family's home for presentation to the child during a videotaped meal. Five food options were offered as unfamiliar foods (i.e., pears, green beans, baked beans, stuffing, yogurt). The selection of these five potential unfamiliar foods was based on the research of Schreck and Williams (2006) and their record of foods typically eaten by children with ASD. Schreck and Williams (2006) found that children with ASD consumed less than 50% of fruit, vegetable, protein, starch, and dairy food options, despite the fact that these foods were consumed by more than 50% of children's families. In the current study, these five food categories were represented in the unfamiliar food options (pears = fruit, green beans = vegetable, baked beans = protein, stuffing = starch, yogurt = dairy). Therefore, these represent foods that could easily be incorporated into the child's meals, because the foods are already eaten in the majority of homes of children with ASD but were not foods eaten by the target child. Of the 38 children included in analyses, a number of children (n = 17, 45%) had been previously presented all of the five food options specifically outlined in study procedures. In these situations where a recruited child had been presented to eat all 5 foods, the researcher worked with the family to identify a food that was eaten by other family members in the home but that had not been previously presented to the child. This criterion (i.e., a food eaten by other family members in the home that had not been previously presented to the child) was similar to the foods selected from the Scheck and Williams (2006) study. See Appendix A for a list of all unfamiliar foods selected by families.

The number of target bites during meals where a child was presented one of the five standard food options did not significantly differ from number of target bites during meals where the child was presented a different unfamiliar food because they had already been given all of the five standard options (F (1, 36) = 1.33, p = .26). Multiple food options were provided rather than using one standardized food because each child's previous experience with food differs, and therefore, it was not likely that all children would be unfamiliar with one particular food.

Parents were given forms to fill out regarding demographics, mealtime behaviors, and their child's diet. Only the demographics form and mealtime rating form was used in the present project. The family was also provided video equipment to record family mealtimes, and the research assistant demonstrated how to operate the equipment. The research assistant set up the video camera on a tripod facing the child's eating area. The camera was focused specifically on the target child, and the camera focus was zoomed in close enough that each child bite could be observed. The camera needed to be zoomed in close enough that the researcher could identify which food the child was eating in each bite. Families were instructed to record 4 family meals, and data from the last meal were used in the current project. The last meal was used in order to minimize the possible effect of the family's reactivity to the camera on their mealtime behaviors. During the last meal, parents gave their child the unfamiliar food. Parents were instructed to provide the food in the same way they would normally present an unfamiliar food, and no specific instructions for the presentation of the food were provided except that the food could not be mixed with other foods. The food could not be mixed, because the researcher would not be able to identify when the child was taking a bite of the unfamiliar food.

Once parents completed the videotaping and the parent-report questionnaires, the researcher returned for the second home visit to collect the completed questionnaires and video

recording equipment. At this second visit, families were given a $20.00 Walmart gift card as compensation for their time. Families kept study materials for an average of 15.29 days (SD = 7.47, range 4 to 38 days).

Measures

***Dyadic Interaction Nomenclature for Eating* (*DINE*; Stark et al., 1995).** The *DINE* is a reliable and valid coding system of mealtime behaviors for children 2- 8 years old. The system is used to code in vivo family mealtimes occurring in the child's home and has been used in several pediatric populations (e.g., cystic fibrosis, type 1 diabetes; Patton, Odar, Midyett, & Clements, 2014; Stark et al., 1995). Validity of the *DINE* has been supported through the measures' ability to differentiate between pediatric populations and the association of *DINE*-coded behaviors to health outcomes (e,g,, Patton, Dolan, & Powers, 2008; Stark et al., 2000)

The *DINE* includes three categories of behavior: Child Eating, Child Behavior, and Parent Behavior. Child Eating measures the frequency of bites and sips and the number of intervals that food is spit out. Child Behavior measures the frequency of compliance/noncompliance to direct commands to eat by parents and the number of intervals containing refusal/complaints about food, child requests for food, child talk, the child being away from table/food, and the child playing. Parent Behavior measures the frequency of direct commands to eat and beta commands to eat, and the number of intervals containing coaxes, reinforcement, parent talk, physical prompts, and parents feeding the child. With the *DINE*, observers record behavior in consecutive 10-second time intervals throughout the videotaped meal. Because study hypotheses were focused on child bites of a specific food (i.e., the unfamiliar food), when completing *DINE* coding, the observers also recorded the number of bites

of the unfamiliar food, specifically, in addition to the standard protocol of coding overall bites. See Appendix B for operational definitions of each behavior coded.

Mealtime videos were prepared for coding using Windows Live Movie Maker. *DINE* coding requires that the video be in 10 second intervals, so videos were prepared so that each 10 second interval was labeled with an interval number at the top of the screen. Videos were then burned to DVDs for coding. Coders watched the video 3 times, each time coding for either child behavior, parent behavior, or eating behavior specifically. This is consistent with procedures using the *DINE* coding system in past research (e.g., Patton et al., 2008; Patton et al., 2014; Powers et al., 2005; Stark et al., 2000), including analyses in which DINE variables served as both the predictors and outcomes in hypotheses (Van Allen, Powers, Dolan, & Patton, 2011).

Prior to beginning coding, all coders were trained until their coding reached reliability with the training videos (Kappa > .60). Training involved receiving instruction on the operational definitions from a professor experienced in use with the *DINE* and coding 12 training mealtime videos. The trainee's coding on these meals was than compared to that of a standard reliability coder, whose coding was verified by the initial creators of the *DINE* and has been used in prior trainings in *DINE* coding. If Kappa reliability scores were greater than .60 for child behavior, child eating, and parent behaviors, the trainee was considered to have passed the training. If reliability standards were not met, the trainee coded additional meals until adequate reliability was reached. Study meals were coded by one primary coder with reliability coding completed by a secondary coder for 25% of the meals (i.e., 10 meals). Random selection was used to identify meals for reliability coding. Reliability of *DINE* coding is assessed using Kappa coefficients, which are established for assessing reliability of nominal variables. Kappa coefficients are computed as the proportion of agreement versus expected agreement and correcting for chance

(Cohen, 1960). Negative coefficients represent that agreement between raters was less than expected by chance and positive coefficients represent that agreement was greater than expected by chance (Cohen, 1968). Kappa coefficients greater than .60 represent adequate reliability (Cohen, 1960). Therefore, the standard for adequate reliability for *DINE* coding has been established as a Kappa coefficient greater than .60 (e.g., Patton et al., 2014; Powers et al., 2005; Stark et al., 2000). While this value is lower than the adequate cut-off for other measures of reliability, it is important to note the difference in calculation of Kappa coefficients because the statistic is corrected for chance, which is not done in other reliability measures (Cohen, 1968). In the current study, reliability was .76 for child behaviors, .62 for parent behaviors, and .83 for child eating behaviors. All of these values were above the .60 Kappa coefficient value deemed as the minimum cut-off for adequate reliability and were similar to those obtained in past research using the *DINE* (Powers et al., 2005; Stark et al., 2005). Kappa coefficient values were used to examine reliability in coding the presence or frequency of each variable within each 10-second interval, but did not evaluate reliability in scoring the sequence of behaviors within each interval. For analyses, coding by the primary coder was used.

Mealtime Rating Forms. A form was created for the current study in order to ensure that only typical home mealtimes were included in analyses. Parents rated the typicality of the meal during which the unfamiliar food was presented on a scale of 1 (Not Typical) to 5 (Very Typical). Parents were asked to take into account all aspects of the child's behavior, the mealtime (e.g., family members present, structure of meal, foods presented), and parent's behavior with the exception of the unfamiliar food being provided at the request of the researcher. Only meals rated as a 3 or higher were included in analyses. See Appendix C for copy of form.

Demographic Data. Demographic data (e.g., child gender, information on socioeconomic status) were collected via parent-report to characterize the sample.

Child Anthropometrics. Child anthropometrics were obtained at the first study home visit using a portable stadiometer and portable SECA digital scale (SECA, Hamburg, Germany). Child height and weight were each measured 3 times, and the median value for height and weight was used to calculate child Body Mass Index (BMI) and BMI percentile. The Baylor College of Medicine BMI graph calculator using age and gender norms was used for calculations (http://www.bcm.edu/cnrc/bodycomp/bmiz2.html). Child BMI percentile was used to classify children as underweight (BMI under the 5th percentile), healthy weight (BMI between the 5th and 85th percentile), overweight (BMI between the 85th and 95th percentile), and obese (BMI over the 95th percentile).

Data Analyses

All statistical analyses were completed with R version 3.0.2 and IBM SPSS Version 22. Logistic regressions were performed to examine whether the frequency of specific parent and child behaviors throughout the meal predicted the dichotomous variable of whether the child tried or did not try a bite of the unfamiliar food. These analyses used a dichotomous outcome variable of "yes" or "no" the child tried a bite of the unfamiliar food. The independent variables in these analyses were the occurrence of each parent and child mealtime behavior across the course of the meal. For example, it was explored whether the number of parental commands during the meal predicted whether the child took a bite of the unfamiliar food.

To test the study hypotheses, a time series analyses was conducted to identify parent and child mealtime behaviors followed by a child bite in the same or subsequent 10 second interval. The time window of the same or subsequent 10 second interval was chosen because *DINE*

procedures require meals to be divided into 10 second intervals. Child bites were considered to follow a mealtime behavior as long as the mealtime behavior was initiated prior to the child placing the food bite in his/her mouth. Child bites of the unfamiliar food served as the target variable in the analyses, and the time-window following each child or parent mealtime behavior was defined as the remainder of the same 10 second interval in which the parent or child mealtime behavior occurred and the subsequent 10 second interval. See Appendix D for a graphical depiction of the time series analyses.

Sequential analyses were performed using a multilevel logistic regression with 10 second mealtime intervals (level 1) nested within participants (level 2). See Appendix D for a figure displaying the nestedness of the data. The total number of level 2 units was the number of total 10 second intervals across all meals (n = 3879). Analyses examined whether the occurrence of parent behaviors (i.e., commands, feeds, physical prompts) and child behaviors (i.e., play, being away from the table) was related to the binary variable of the child taking or not taking a subsequent bite of the target food in the same or following 10 second interval. Most mealtime behaviors were recorded on an occurrence/non-occurrence basis for each 10 second interval. However, a small number of behaviors were recorded as frequency counts during each interval (e.g., commands, feeds). Given the low variability in the frequency of occurrence of these variables (e.g., very few instances of occurrence > 1 occurred), these variables were dichotomized as occurrence versus non-occurrence for data analyses. Analyses were completed using the "glmer" function and the full information maximum likelihood estimator (FIML). Models were first specified using a random intercept and fixed slope, meaning the relationship between the mealtime behavior and target bites was not allowed to vary across participants. Next, the models were specified using a random slope, where the effect was allowed to vary

across participants. Chi-square difference tests were calculated to examine whether the fixed or random effect model was more appropriate for modeling the relationship between each behavior and target bites.

Results

Participant Descriptives

Participants were 27 (71.05%) males and 11 (28.95%) females ranging in age from 2 years 5 months to 8 years 10 months (*M* age = 5.80, *SD* = 2.01). Children were predominantly Caucasian (*n* = 22, 57.89%) and included families from a range of family annual incomes Approximately 95% of children received services to address symptoms and associated features of ASD either currently or in the past. Information was not available on whether these services were in the past or current. See Table 1 for a complete list of both past and present therapies and services received by children in the sample. See Table 2 for complete participant demographics.

Table 1: Therapies and Services That Children Received to Address Symptoms and Associated Features of ASD

Child Received Services	**n (%)**
Yes	36 (95%)
No	2 (5%)

Specific Services Received	**n (%)**
Speech	28 (74%)
Occupational Therapy	26 (68%)
Applied Behavior Analysis/Other Behavior Therapy	19 (50%)
Physical Therapy	4 (11%)
Feeding Therapy	2 (5%)
Unspecified Services/Other	13 (34%)

Table 2: Participant Characteristics

	n (%)
Gender	
Male	27 (71.05%)
Female	11 (28.95%)
Ethnicity	
Caucasian	22 (57.89%)
African-American	7 (18.42%)
Biracial	7 (18.42%)
Hispanic	2 (5.26%)
Family Annual Income	
$0- $19,999	8 (21.05%)
$20,000- $39,999	5 (13.16%)
$40,000- $59,999	5 (13.16%)
$60,000- $79,999	7 (18.42%)
$80,000- $99,999	2 (5.26%)
$100,000 +	10 (26.32%)
No Response	1 (2.63%)
Medication Currently Taken to Manage Behavior or ASD Symptoms	
Yes	16 (42.11%)
No	22 (57.89%)
Medications Currently Taken	
Stimulants	7 (18.42%)
Guanfacine	5 (13.16%)
Fluoxetine	5 (13.16%)
Risperidone	2 (5.26%)
Other	4 (10.53%)
Weight Status*	
Underweight	None
Healthy Weight	26 (68.42%)
Overweight	5 (13.16%)
Obese	7 (18.42%)

	mean (SD), range
Age	5.80 (2.01), 2.43 to 8.85

* Underweight defined as a Body Mass Index (BMI) under the 5th percentile, healthy weight defined as BMI between the 5th and 85th percentile, overweight defined as BMI between the 85th and 95th percentile, and obese defined as BMI over the 95th percentile.

Mealtime Descriptives

Videotaped meals lasted an average of 17.00 minutes (*SD* = 9.62, range: 1.00 minute to 39.67 minutes). One meal only lasted for 1 minute, because the child's parent chose to discontinue the meal when their child displayed significant refusal of the unfamiliar food. However, this meal was rated as typical by the child's parent, and therefore, it was still included in the analyses. On a scale from 1 (Not Typical) to 5 (Very Typical), the average rating for included meals was 4.24 (*SD* = .71). Table 3 presents the frequency of the parent and child mealtime behaviors examined. Mealtime behaviors are presented as the average occurrence per minute.

Table 3: Rates of Occurrence of Child and Parent Behaviors During the Meal

	Rate Per Minute
Child Eating Behaviors	
Bites of Non-Target Food	2.65
Sips	.25
Bites of Unfamiliar/Target Food	.18
Feeds	.12
No Plate	.08
Spit-Ups	.04
Child Behaviors	
Child Talk	2.10
Child Away	.69
Refusal	.43
Play	.33
Request for Food	.11
Cry (Unrelated to Food Refusal)	.01
Parent Behaviors	
Parent Talk	1.99
Beta Commands*	.50
Coax	.29
Command	.27
Physical Prompt	.23
Reinforcement	.09

* Beta commands are defined as parent commands to eat that are followed by parent talk or an additional parent command before the child has an opportunity to comply (i.e., within 5 seconds)

Twenty-two children (57.89%) took a bite of the unfamiliar food. Children who took a bite of the unfamiliar food took an average of 3 bites (*SD* = 5.11, range: 1 to 21 bites). The number of target bites did vary based on the type of unfamiliar food presented (F (4, 33) = 3.03, p = .03). However, this relationship was no longer significant when the observation of the child who took 21 bites of the unfamiliar food (i.e., the highest value) was removed (F (4, 32) = 1.94, p = .13). Children presented with pears as the unfamiliar food took the most bites (*M* = 7.88, *SD* = 8.94), and children presented with baked beans never took a bite of this unfamiliar food. See Table 4 for the average number of bites by type of unfamiliar food.

Table 4: Number of Bites Taken of Each Unfamiliar Food

Unfamiliar Food	Mean Number of Bites Per Meal (SD)
Pears (n = 8)	7.88 (8.94)
Stuffing (n = 8)	2.25 (3.33)
Broccoli (n = 4)	1.50 (1.29)
Baked Beans (n = 5)	0.00 (0.00)
Other Food (n = 13)	2.07 (2.33)

Differentiating Children Who Did and Did Not Take a Bite of the Unfamiliar Food

In the logistic regression analyses examining which behaviors throughout the meal predicted whether a child took a bite of the unfamiliar food (i.e., aggregate scores of these behaviors throughout the meal predicting the dichotomize outcome of "tried" or "did not try"), child sips during the meal was the only significant predictor (z = - 2.42, p = .02). Children who did not take a bite of the unfamiliar food took more sips of a drink during the meal. No other parent, child, or eating behavior predicted whether children took a bite of the unfamiliar food.

Hypothesis 1: Direct Commands

Sequential analyses examined which parent and child mealtime behaviors were associated with increased likelihood of the child taking a bite of the unfamiliar food in the same or subsequent interval. As hypothesized, parent commands to eat (z = 2.01, p = .04) were

associated with subsequent bites of the unfamiliar food. The association between parent commands and bites of the target food was adequately modeled as a fixed effect and not better modeled as a random effect (χ^2 (2) = 2.56, p = .28), meaning the effect of parent commands did not vary across children. Children responded similarly to parent commands.

Hypothesis 2: Parent Physical Prompts and Feeds of the Child

Parent feeds (z = 6.69, p < .001) was significantly related to greater likelihood of subsequent bites of the unfamiliar food. The association between parent feeds of the child and bites of the unfamiliar food was better represented as a random effect (χ^2 (2) = 12.42, p < .01), meaning that the effect of feeds on target bites was different across children.

Given the effect of parent feeds was found to vary across children, a follow-up analysis was performed to examine possible interactions between child factors and the effect of feeds. Specifically, the child's gender, the child's age, whether the child currently took psychotropic medications, and whether the child was normal weight (BMI between the 5th and 85th percentile) compared to overweight/obese (BMI over the 85th percentile) were entered into the model. A trend was found for psychotropic medications (z = -1.81, p = .07), suggesting the impact of feeds on child bites may have been different for children on psychotropic medications in comparison to children not on psychotropic medications. The interaction was probed by examining the effect of feeds separately for children taking and not taking medications to address behavioral or psychological symptoms. The model was run without containing other interaction terms since these were found to be non-significant. Feeds were related to subsequent bites of the unfamiliar food by children on medication (z = 3.15, p < .01) but not children who were not taking medication (z = 1.36, p = .18). Other interactions explored were not found to be significant [child gender (z = .64, p = .52), child age (z = -.18, p = .86), weight status (z = - .27, p = .78)].

Contrary to the hypothesis, the variable of parents providing physical prompts to eat was not associated with the child taking a bite of the unfamiliar food in the same or subsequent interval ($z = .56$, $p = .58$).

Hypothesis 3: Child Mealtime Behaviors

Regarding child mealtime behaviors, the child being away from the table was associated with fewer bites of the unfamiliar food in the same or subsequent interval ($z = -2.39$, $p = .02$), consistent with study hypotheses. The effect of the child away from the table was found to be consistent across children and was not better modeled as a random effect ($\chi^2(2) = 3.90$, $p = .14$). Also as hypothesized, the child playing was associated with fewer subsequent bites of the unfamiliar food. All instances of child play were not followed by a bite of the target food in the same or subsequent interval. A statistic for the association between child play and bites of the target food was unable to be computed, because there was no variability (i.e., the model perfectly predicted bites of the target food).

Exploratory Analyses

Exploratory analyses examined whether other parent or child mealtime behaviors were associated with bites of the target food in the same or subsequent interval. Child talk (not related to food requests or food refusals) was associated with lower frequency of the child taking a bite of the unfamiliar food in the same or subsequent interval ($z = -2.59$, $p < .01$). The association between child talk and bites of the target food was adequately modeled as a fixed effect and was not better modeled as a random effect ($\chi^2(2) = 0.13$, $p = .94$), meaning that the effect of child talk did not vary across children. Other parent behaviors [i.e., beta commands (those interrupted by other parent verbalizations), parent talk, coaxing, reinforcement] and child behaviors (i.e.,

requests for food and food refusals) were not associated with number of bites eaten of the unfamiliar food in the same or subsequent interval.

Discussion

The current study examined parent and child mealtime behaviors related to consumption of an unfamiliar food by children with ASD in a typical home meal using an observational methodology. Interestingly, few behaviors differentiated children who took a bite of the unfamiliar food from those who did not take a bite of the unfamiliar food. Only the number of sips of drink taken by the child during the meal significantly predicted whether children would take a bite of the unfamiliar food with greater sips decreasing the likelihood of bites. However, several parent and child mealtime behaviors were related to subsequent consumption of the unfamiliar food within the same or subsequent 10 second interval (e.g., parent commands, child being away from the table, direct feeds of the child).

Differentiating Children Who Did and Did Not Take a Bite of the Unfamiliar Food

Children who took more sips of drink during the meal were less likely to take a bite of the unfamiliar food. Given that taking sips of drink and a bite of food cannot occur simultaneously, greater sips of drink may minimize the opportunities for bites of the unfamiliar food. Children may also take sips of drink to distract from parental demands to try a food or as a stall tactic for avoiding taking a bite of food. Further, it could be the case that children who take a large number of sips begin to feel fullness or satiety simply from their consumption of the drink, and therefore, these children are less likely to try a bite of the unfamiliar food. This may especially be the case in situations where children are provided drinks that have higher caloric and nutritional content (e.g., milk).

The fact that only one parent or child mealtime behavior (i.e., child sips of drink) differentiated between children who did or did not take a bite of the unfamiliar food suggests that additional factors about the meal, the child, and the parent may play a bigger role than mealtime behaviors in determining which children try unfamiliar foods at mealtimes. For example, child factors such as sensory sensitivity, motor impairments, language difficulties that impair ability to understand commands, and ASD severity may impact whether the child takes a bite of unfamiliar foods at mealtimes. However, research has not consistently supported an association between ASD severity and food selectivity (Schreck & Williams, 2006). Furthermore, there may be other aspects of family home mealtimes not assessed by the current study that predict whether children with ASD try unfamiliar foods. For example, the number of people present at the home mealtime (e.g., whether parents sit down with the child), whether the unfamiliar food was given to all family members at the meal, or the child's preference for other foods presented at the same meal) may impact whether children try an unfamiliar food presented. Food selectivity in children with ASD has been related to the extent the family eats a more restrictive diet, and family eating patterns are a greater predictor of child food selectivity than severity of ASD symptoms (Schreck & Williams, 2006).

Parent Commands and Coaxes

Parent commands to eat increased the likelihood of subsequent bites of the unfamiliar food by the child within a close temporal window. This is consistent with prior research that has found parental prompts for eating are related to greater food consumption (McKenzie et al., 1991). Further, past research has identified that limited child diet variety is related to greater parental permissiveness and less attempts to increase consumption of food (Williams et al., 2008), and parental permissiveness is essentially the opposite of parental commands.

Interestingly in the current study, these commands were only found to be effective for increasing bites of the unfamiliar food when the command was followed by an opportunity for the child to comply (i.e., take a bite of the food), and parent commands were not found to be effective when the command was followed shortly (i.e., within 5 seconds) by talk or additional commands by the parent. Further, parent coaxes (defined as offers of additional food, encouraging positive evaluations of food, vague commands, or making games out of eating) were not related to subsequent bites of the unfamiliar food within a close temporal window. These findings suggest that direct commands to eat are more effective for increasing child consumption of foods than other parent verbalizations meant to increase food consumption. This is consistent with prior research in other populations which has found parental commands to be positively associated with increased child food intake (e.g., Iannotti, O'Brien, & Spillman, 1994). Parent instruction on providing direct commands may be a helpful component for feeding interventions for this population, including the opportunity to practice this skill. Further, parents might be discouraged from making attempts to coax their child to eat an unfamiliar food. Additionally, interventions could educate parents on the importance of giving their child an opportunity to comply with commands to eat before providing additional commands or engaging in other verbal interactions with their child.

Parent Feeds of the Child

Direct feeds of the child by the parent were also related to increased likelihood of subsequent bites of the unfamiliar food in the same or next 10 second interval, which is consistent with research in applied behavior analysis that found bringing the food to the child's mouth, through strategies such as non-removal of the spoon, to be effective for increasing bites (Kerwin, 1999). Parents in the current study, however, did not follow the exact rules and

procedure for the non-removal of the spoon technique, but this strategy was still found to be effective. Perhaps, variations of techniques used in applied behavior analysis may also be effective. Direct feeds of the child may also be particularly effective with children with ASD, because it may eliminate some of the impairment at mealtimes caused by poor fine motor skills. Many children with ASD experience poor motor skills, and oral motor skills deficits have been associated with feeding problems (Dailey, 2009). By directly feeding the child, parents reduce the amount of motor skills that may be needed by the child to consume foods. It should be highlighted that the current study found the effect of direct feeds of the child to differ across children, meaning this strategy may only be effective for certain subsets of children. Feeds were found to be effective for children taking psychotropic medications to address behavioral or psychological symptoms, but this mealtime behavior was not related to subsequent bites of food by children not on medications. It may be the case that children taking medication are more severely impaired, and therefore, the concrete prompt of parent feeds is more effective because it does not require verbal communication and requires less motor skills.

Parent Physical Prompts

Interestingly, other physical prompts to eat, including putting the child's food on a fork or pointing to the child's food, were not associated with greater frequency of subsequent bites. Reducing some of the demand for motor skills to take a bite (e.g., putting the food on the fork so the child only has to pick up the fork) was not enough to increase the likelihood of children taking a bite. This finding is in contrast to study hypotheses that the more concrete prompt for children to eat would be related to increased consumption of the unfamiliar food, since it did not involve understanding language or the nuance of verbal prompts. The fact that verbal commands were found to relate to increased likelihood of subsequent bites and that this effect did not differ

across children suggests that children of varying language abilities may be able to understand verbal commands to eat, and therefore nonverbal physical prompts may not be necessary. Parents may adequately tailor the complexity of commands and the words used to a level that their child can easily understand. The effectiveness of verbal prompts may explain why physical prompts were not more effective for increasing the likelihood of subsequent bites of the unfamiliar food.

Child Mealtime Behaviors

In addition to parent mealtime behaviors, some child mealtime behaviors were related to subsequent bites of the unfamiliar food. Specifically, children being away from the table, children talking, and children playing at the dinner table were all related to fewer subsequent bites of the unfamiliar food. Past research has also supported an association between children playing with their food and feeding difficulties (Sanders et al., 1993). These behaviors may distract children from eating, including taking bites of the unfamiliar food. Additionally, the occurrence of these child behaviors at mealtimes may signify less parental control and less structure at these meals, which may relate to children being less likely to try unfamiliar foods or meet parent demands at meals. Interventions targeting mealtime behaviors and food selectivity in this population should help parents to eliminate the time their child spends away from the table or playing with toys at home meals. The current study also suggests that if the goal of mealtimes is to introduce a new unfamiliar food, child conversation focused on topics besides eating may decrease the likelihood of consumption of the unfamiliar food.

Although some child mealtime behaviors were associated with likelihood of a subsequent bite of an unfamiliar food, child food refusal was not significantly related to less subsequent bites of the unfamiliar food. Children who express complaints about food or refuse to eat a food may still eat a bite of the food in a subsequent interval. Therefore, parents should continue to present

their child with non-preferred foods even if their child refuses the food. Parents could be informed through intervention efforts that child complaints about food do not necessarily mean that the child will not try a bite of the food if appropriate commands and supports are provided.

Use of the *DINE* with Children with ASD

The current study was the first use of the *DINE* to code mealtime behaviors of children with ASD and their families. In coding the videos, it was found that behaviors more common among children with ASD (e.g., food refusal, sensory sensitivities influencing food selections, many instances of self-stimulation) fit within the operational definitions of mealtime behaviors. For example, sensory sensitivities sometimes resulted in food refusals, which fit within the operational definition of refusal. Another example is that repetitive motions with toys or foods fit within the definition of play. Further, the *DINE* bases consideration of what child verbalizations are counted as "child talk" on whether the child is verbal or non-verbal, and therefore, the operational definition for this variable was adjusted for children with ASD who did not have verbal communication. Specifically for non-verbal children, all vocalizations count as "child talk," even if the vocalization does not use words.

Kappa reliability scores were similar in the current study to those found when the *DINE* is used in other populations (e.g., Powers et al., 2005; Stark et al., 2005). In the current study when used with children with ASD, reliability was .76 for child behaviors, .62 for parent behaviors, and .83 for child eating behaviors. Comparable values were found for reliability scores when used with children with cystic fibrosis (Powers et al., 2005; child behaviors: .76, parent behaviors: .60, child eating behaviors: .80). Stark and colleagues (2005) also found similar reliability scores when using the *DINE* (child behaviors: .76, parent behaviors: .70, child eating behaviors: .92). However, some work with children with type 1 diabetes has found

slightly higher Kappa reliability scores (Patton et al., 2008; child behaviors: .80, parent behaviors: .68, child eating behaviors: .90). This suggests that while the *DINE* performed adequately in use with children with ASD, there may be some room for additional improvements in operational definitions.

Clinical Implications

The current study findings provide valuable information that can inform interventions for food selectivity in children with ASD. While past research has identified time-intensive, complex, and intrusive treatments for addressing food refusal and food selectivity, the current study examined parent behaviors that can be used during typical family meals without requiring training or modeling from professionals. These are mealtime behaviors that are already part of parent and child behavior repertoires and that are associated with increased consumption of unfamiliar foods. Past research has found that intervention efforts can be effective for modifying parent mealtime behaviors (e.g., Patton et al., 2014; Stark, Powers, Jelalian, Rape, & Miller, 1994). Behavioral parent training groups have led to changes in mealtime behaviors of children with chronic conditions and their families, including a reduction of some parental mealtime behaviors found to be ineffective in the current study (e.g., parent coaxes; Patton et al., 2014). These interventions are often able to be conducted with only parental involvement, meaning the burden of needing to involve their children directly in the intervention group is eliminated. This procedure may be particularly helpful among children with ASD who may have difficulty attending treatment groups due to their social skills deficits or difficulties in interacting with other children. Intervention efforts through a group treatment modality may be effective for this population given that the current study found the relationship between most parent and child mealtime behaviors and subsequent bites of an unfamiliar food did not differ across children.

Therefore, information presented to a group is likely to be beneficial for most parents, regardless of their child's specific symptom presentation or level of functioning.

Additionally, past research has suggested that lower intensity interventions, such as brochures circulated to mothers, can be effective for modifying mealtime behaviors. McMahon and Forehand (1978) found that brochures presenting parents with behavioral management techniques to address problematic child mealtime behaviors, such as differential attention and timeout, led to a 50-80% reduction in problematic child mealtime behaviors.

Limitations

One strength of the current study is that children were not excluded based on receiving prior services (e.g., occupational therapy, behavioral therapy), making the sample representative of the greater population of children with ASD. These types of services are commonly received by children with ASD. For example, nearly 80% of children with ASD receive occupational therapy (McLennan, Huculak, & Sheehan, 2008), and in the current sample, almost 70% of children received occupational therapy services. Therefore, given the frequent receipt of such services and the incorporation of feeding strategies into these services (e.g., Case-Smith & Miller, 1999), children receiving services that addressed feeding were included in the current sample in order to support the generalizability of study findings to the larger population of children with ASD. However, including these children in our sample also may have confounded the ability to identify behaviors naturally occurring at home mealtimes, because parent and child mealtime behaviors may have been modified as a result of strategies learned through intervention services. Further, the current study did not distinguish whether children were currently receiving services or whether the services were received in the past.

Another potential limitation of the current study is that children from a wide age range were included. Yet, while children 2 through 8 years old show many developmental differences, past research using the *DINE* has found little variation in the mealtime behaviors examined across children of varying ages (Odar, Powers, Dolan, Smith, & Patton, 2013). Specifically, no differences in child mealtime behaviors were found between children under and over 5 years old, and many parent mealtime behaviors (e.g., commands, coaxes, parent talk) also did not differ between age groups. However, child age was inversely related to parent use of reinforcement, physical prompts, and feeds. In the current study, most effects for mealtime behaviors were not found to vary across children, suggesting that age did not moderate these effects.

The current study did not assess severity of ASD symptoms, and therefore the impact of severity on food selectivity could not be assessed. Given mealtime behaviors did not differentiate children who tried a bite of the new food from those who did not, severity of ASD symptoms may have explained some of this variance. Further, parent feeds of the child were found to only increase likelihood of subsequent bites of the unfamiliar food by children taking psychotropic medications, which may have been a proxy for ASD severity. However, it could not be assessed if differences in symptoms severity were responsible for this difference between child taking and not taking psychotropic medications. Nevertheless, the relationship of most mealtime behaviors to subsequent bites of the new food was found to not vary across children, suggesting that symptom severity did not relate to the effectiveness of these behaviors. Lastly, while child ASD diagnoses were verified using the child's medical record or other report documentation, the method of diagnosis was not consistent across all children because diagnoses were provided by a number of different providers at a number of different institutions.

Several methodological limitations were also present in the coding of mealtime behaviors. First, both the independent variables (i.e., parent and child mealtime behaviors) and dependent variable (i.e., bites of the unfamiliar food) were obtained from the same coding system and coded for by the same researcher. However, adequate inter-rater reliability was demonstrated for parent, child, and eating behaviors, suggesting that researcher biases due to knowledge of the study hypotheses could have had only a minimal effect on the reliability of the coding. Secondly, the presence of the camera at home mealtimes may have caused parents and children to modify their mealtime behaviors. Consistent with the "Hawthorne effect", families may have modified their behaviors, because they were aware that they were being observed. However, the current study used the final meal in a series of 4 videotaped meals, and reactivity to the camera likely decreased over the series of recordings. Lastly, only one meal for each family was used in the current analyses, and mealtime behaviors may differ across meals, making the findings less generalizable to other meals. However, parent did rate the meals as typical for their child, meaning these were likely representative of other meals.

Future Directions

Future research should continue to examine food selectivity at home mealtimes in children with ASD, including mealtime correlates and intervention strategies. Given the association between child sips and whether or not children took a bite of the unfamiliar food, future research should examine the types of drinks provided at home mealtimes and if the type of drink provided relates to bites taken of unfamiliar foods. Perhaps, presentation of certain types of drinks (e.g., high caloric drinks) during mealtimes may hinder children from trying unfamiliar foods. Future observational research should examine whether the type of drink provided at meals

relates to taking a bite of the unfamiliar food, and future experimental research should examine this association by manipulating the types of drinks provided at home meals.

Additionally given that sips was the only mealtime behavior that differentiated between children who took a bite of the unfamiliar food from those who did not, future research should examine other child, parent, or mealtime factors that may be related to child food selectivity. The current study results suggest that aspects of the unfamiliar food itself may influence whether children try a bite of the food, because the average number of bites taken varied across the different unfamiliar foods. Developing a better understanding of other child, parent, and mealtime behaviors that may determine whether children take a bite of unfamiliar foods at mealtimes should be a goal of future research and will help with tailoring food selectivity interventions to the needs of families of children with ASD. Examining the impact of the severity of children's ASD will also be important given the current study found different effects of one parent mealtime behavior depending on whether the child was taking psychotropic medications, which is likely a correlate of ASD symptom severity.

While adequate reliability standards were met for child behaviors, parent behaviors, and child eating on the *DINE,* level of agreement between the primary and reliability coder was found to vary across the different behaviors. Specifically, the agreement of coding for parent behaviors was below that of child behaviors and child eating. As mentioned previously, the Kappa scores in the current study were similar to those in past research, which suggests parent behaviors may be more difficult to code using the current operational definitions. Therefore, future validation and refinement of the *DINE* should focus on modifying and improving the operational definitions for mealtime behaviors, especially for parent behaviors.

Conclusions

The current study provides information on parent and child mealtime behaviors that should be targeted in interventions for food selectivity in children with ASD. Understanding factors related to food selectivity in children with ASD is particularly important given the high prevalence of food selectivity in this population (Lockner et al., 2008; Provost et al., 2010) and its significant impact on nutrition and family life (e.g., Bandini et al., 2010; Kodak & Piazza, 2008). Clinical interventions for food selectivity in children with ASD should provide parents education on effective mealtime parenting strategies (e.g., commands and feeds) and appropriate child mealtime behaviors (e.g., not playing at the table, not being away from the meal), including providing parents with strategies to reinforce appropriate child mealtime behaviors. Future research should develop and examine the effectiveness of interventions tailored to the needs of families of children with ASD, including the effectiveness of interventions for modifying mealtime behaviors in this population.

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Appendix A

Unfamiliar Foods Provided to Children

Food	**n (%)**
Pears	8
Stuffing	8
Baked Beans	5
Broccoli	4
Purple Cauliflower	2
Radishes	2
Spinach	2
Apple Sauce	1
Artichoke	1
Asparagus	1
Kale	1
Kiwi	1
Okra	1
Pasta	1

Appendix B

Abbreviated Operational Definitions of Behaviors Coded Using the *DINE*

Parent Behaviors	
Commands (Alpha)	Parent verbalizations specific to eating to which a motoric response is appropriate and feasible. Commands may be in the form of an order, question, rule, or contingency. e.g., "Eat your peas."; "You should eat now."; "If you eat your potatoes, you can have dessert"
Beta Commands	Commands that would have been Commands (Alpha), but there was no opportunity to comply because 1) the command was followed within 5 seconds by a parental verbalization or 2) the parent restricted the child's mobility or removed food/drink
Coaxing	A verbalization about food or eating that does not qualify as a command but has the goal of increasing the child's consumption. This includes offers of food, encouraging positive evaluation of food, making eating a game, or commands so vague that it is unclear eating is the behavior to be initiated. e.g., "Come on."; "Isn't this hamburger good?"
Reinforcement	Positive verbal or physical behavior by the parent that is directed to the child after he/she eats or drinks. Reinforcement can be either verbal or physical. e.g., "Good job."; clapping
Parent Talk	Verbalizations not referring to food or eating
Physical Prompt	A physical action by the parent to indicate to the child to eat or drink. e.g., pushing the child's plate closer to the child; pointing to the child's food; scraping child's food into a pile
Eating Behaviors	
Bite	Any taking of solid food through the mouth and passing between the child's lips.
Sip	Bringing a glass, cup, straw, or spoonful of liquid to the lips.
Spit-up	Any time the child spits-ups, spits out, or purposely drops food from his/her mouth.
Feed	Parent attempts to put food in the child's mouth with no attempt to have the child help.

Plate Away	Any time someone moves the child's plate out of his/her reach.
Child Behaviors	
Food Refusal	When the child lets the parent know that he/she does not want more food or complains about the taste of food. Refusals can be verbal or non-verbal. e.g., "Take it away."; "Yuck!"; turning head away from a feed, gesturing for food to be removed
Requests for Food	Any verbal or nonverbal child initiated behavior in which the child asks for additional food e.g., direct verbalizations/requests for food ("Can I have a cookie?"); pointing to food
Child Talk	For non-verbal children: any vocalization, including nonsense syllables For verbal children: recognizable conversation or words
Play	Play with toys or use of food-related materials as play objects e.g., playing with a doll or car; moving a fork through the air and pretending it is an airplane
Away	Any time the child is more than an arm's length from their food, puts their head below the table, or turns their back to the food

Appendix C

Mealtime Rating Form

Mealtime Questions

Meal #_____

Date of Meal _____

Time of Meal _____

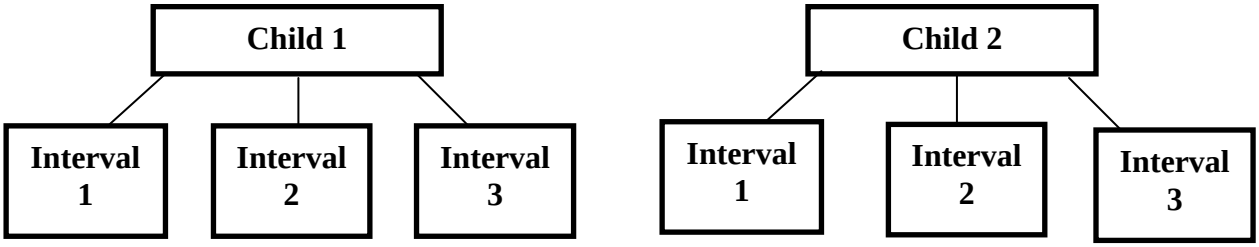
Type of Meal □ lunch □ dinner

How similar was this meal to your child's typical meals at home (including his/her behavior, behaviors of other family members at the meal)?

1	2	3	4	5
Not Typical				Very Typical

Appendix D

Multilevel Logistic Regression from Sequential Analyses



Note: Each level 1 unit (i.e., each 10 second interval within the meal) was nested within each level 2 unit (i.e., each child participant).

	0:00- 0:10	0:10- 0:20	0:20- 0:30	0:30 – 0:40	0:40- 0:50	0:50- 0:60
Parent	X			X		
Child						

Note: The time series analyses explored mealtime behaviors followed by a child bite in the same or subsequent 10 second interval. The above figure shows an example of the time window that would follow a parent mealtime behavior.