Oral-motor Movement Patterns in Feeding Development

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ORAL-MOTOR MOVEMENT PATTERNS IN FEEDING DEVELOPMENT

by

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A dissertation submitted in partial fulfillment of

the requirements for the degree of

Doctor of Philosophy

(Communicative Disorders)

at the

UNIVERSITY OF WISCONSIN-MADISON

2010

ABSTRACT

Purpose: This study examined whether a set of feeding-relevant oral-motor skills that were clinically observable would reveal differences among transitional feeders based on their age and on their experience with eating different textures. The study also examined emergence and mastery of the target oral-motor skills by age and experience groups.

Subjects: Sixty-three typically developing children 8, 10, and 12 months of age (21 per group) were studied. Children had at least two weeks experience eating smooth pureed foods, were healthy, and were growing adequately. Children were grouped according to chronological age and their experience (in weeks) with different textures.

Methods: A comprehensive pool of oral-motor skills for typically developing children was identified from the literature. Expert validation procedures were used to determine which skills were important and observable. Operational definitions for each skill were developed based on the literature. Fifty-two different oral-motor skills were identified. Children were then examined for presence of the 52 skills. Skills were observed and scored on three trials each of five textures. Independent t-tests were used to examine differences by age, experience, and texture for each skill.

Results: There were differences among children of different age and experience groups on certain target oral-motor skills, both within and across textures. However, there were fewer differences than expected. Analyses by experience showed differences among groups for feeding-specific oral-motor skills, while analyses by chronological age showed differences in oral-motor skills associated with gross motor development. Across age, experience, and textures, children in this study mastered a common set of 21 of the 52 target skills at the 75% level.

Implications: Children develop and acquire important oral-motor skills during the first year of life. However, acquisition of the specific oral-motor skills examined in this study may plateau, showing few developmental changes, between the ages of 8 and 12 months. Children perform a greater number of oral-motor skills on a variety of textures at younger ages than previously thought.

ACKNOWLEGEMENTS

There are so many people that I wish to thank for their unending support and encouragement over the past eight years…

Dr. Katie Hustad…you pushed me harder and farther than I ever imagined possible and in the end, I became a researcher. Your constant encouragement and dedication to me, and this project, are invaluable.

Drs. Nadine Connor, Susan Ellis Weismer, Dan Bolt, Ruth Benedict, and Joan Arvedson…your time and carefully considered thoughts and insights helped to make this a project that I can be proud of.

Sue Marks…you provided me an opportunity to work in a department with amazing clinicians that inspire thought and questions and you have supported me with enthusiasm at every step.

Robert Beecher…you are the epitome of a mentor…you have reveled in my successes. I owe you for instilling in me the passion and the desire for pediatric feeding and the care it takes to ask good questions. I will carry on with care.

Dr. Colin Rudolph…your excitement and enthusiasm and compassion are noteworthy…you knew before I did where I could go in life and you provided opportunities for me to grow. For that I can't thank you enough.

Dr. Joan Arvedson…for your confidence in me to succeed and obtain my PhD when I didn't think it was possible; for providing a model for how to juggle it all, particularly on those tough days; and for your generosity and critical thinking, both of which have made me a better clinician and thinker.

Dr. Caryn Easterling…for your early words of wisdom and resources that made starting the process possible…and along the way you have provided me perspective that I will carry forward.

Dr. Ray Kent…for taking a chance on me and for supporting my area of interest when it wasn't popular...you are an icon and I am honored to have had the chance to work with you.

Family and Friends…for those who were always interested and cared to ask, it meant the world to me.

Christian Stilp…future PhD…as a brother-in-law, you are awesome! You listened and answered innumerable questions about statistics and excel formulas. You have been a true agent to the cause.

Rebecca Hefter Stilp…my sister and future PhD…the phone conversations on my long drives to Madison kept me sane, the common confusion about statistics always made me feel a little better (how far we've come), and the sharing of our experiences through this similar process will be unforgettable. I'm so proud to have you as my sister.

My parents…you taught me about work ethic, perseverance, and resilience…a true recipe for success; and for your unconditional love and support.

Justice…woman's best friend…he has been my constant companion for five years giving me encouragement when I was doubtful, for listening to my countless drafts with enthusiasm, and for requesting walks to encourage me to get out and smell the fresh air.

Kevin…my husband…it has been a long and winding road…I can't express enough how much your constant support and dedication have pushed me through this process. I couldn't have done this without you. Your unconditional love astounds me and I am the luckiest woman in the world to have you by my side.

…and to all the families that participated in this study, I am truly grateful.

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STATEMENT OF THE PROBLEM

Oral feeding is a complex developmental process that begins before birth (Delaney & Arvedson, 2008). The most important function of feeding is nutritional intake, which is critical for sustaining life and for adequate growth and development. A complex interplay of neurosensory, neuromotor, and behavioral aspects of feeding occurs during feeding development. Differences or problems in any of these areas, particularly oral sensorimotor skills, may affect feeding and growth.

Children with developmental disabilities are at significant risk for feeding problems. In fact, studies suggest that 30 to 80% of children with identified developmental disabilities have some form of mealtime difficulty, and 40% of these children have subsequent nutritional problems (Ahearn, Castine, Nault, & Green, 2001; Matson & Kuhn, 2001). Further, in children for whom developmental delays have *not* previously been identified, early feeding problems may be one of the first indicators of potential developmental concerns (Mizuno & Ueda, 2005). Previous studies have demonstrated that many infants with poor growth had an onset of feeding problems in late infancy during the transitional feeding period (6-12 months of age) (Dahl & Kristiansson, 1987; Drewett & Young, 1998) and one large feeding disorders clinic reported that more than 50% of referrals were for children under one year of age (Rommel, De Meyer, Feenstra, & Veereman-Wauters, 2003). One reason that children are particularly vulnerable during the transitional feeding period is because the acquisition of oral sensorimotor and feeding skills necessary for intake of advanced textures requires increasingly complex oral-motor control and coordination. Refinement of these skills continues into early childhood (Green, Moore, Ruark, Rodda, Morvee & VanWitzenburg, 1997; Morris & Klein, 1987, 2000). The American Dietetics Association recommends a general order of food introduction beginning with spoon

feeding of a smooth puree food (e.g., infant cereal and in the U.S. Stage 1 baby foods) by 6 months of age in typical infants. Thicker pureed foods (e.g., Stage 2 baby foods) should be offered between 7 and 9 months of age with gradual introduction of foods with texture, such as textured pureed foods (e.g., mashed banana, Stage 3 mixed textures at 6-9 months), dissolvable solids (e.g., soft cracker at 6-9 months), soft diced solids (e.g., fruits and vegetables at 9-12 months), and eventually a general toddler diet of table foods by 12-18 months of age.

Speech-language pathologists are often called upon to determine if a feeding disorder is related to oral sensorimotor differences interfering with advancement in texture. Early identification and treatment of feeding disorders related to oral-motor differences are necessary to ensure proper nutrition, growth, and subsequent development. The lack of data for identifying oral sensorimotor differences could lead to dire consequences (e.g., malnourishment, aspiration, choking), or inappropriate identification and treatment of children with feeding problems (false positives or false negatives). Furthermore, earlier identification of feeding disorders may aid in earlier identification of development delay or disorder. Clearly, it is imperative that clinicians have accurate and reliable normative data pertaining to the development of oral sensorimotor skills for feeding. However, extant normative data are very limited and are fraught with problems.

This research focuses on children who are in the transitional feeding period, which is defined as the time during development when infants between 6 and 12 months of age are introduced to foods other than formula or breast milk and become reliant on those foods for a majority of their nutritional intake. The existing literature describing oral sensorimotor skill development for feeding does not provide adequate evidence for determining normal skill acquisition for advanced textures, primarily because it originated from a very limited sample. A

general progression of oral sensorimotor skill development has been described, but this progression is equivocal because of problems with the limited research upon which it is based. Problems include small sample sizes, lack of age stratification, lack of standard procedures for assessing oral-motor skills, and lack of operational oral sensorimotor skill descriptions.

It is noteworthy that adequate standardized tests are not available to evaluate oral sensorimotor skill development. Existing measures were developed from older typically developing children and were intended for use with neurologically impaired populations (Kenny, Koheil, Greenberg, Reid, Milner, Moran & Judd, 1989; Stratton, 1981). Only one published measure was intended for transitional feeders, the Schedule for Oral Motor Assessment (SOMA) (used for children 8 through 24 months of age) (Reilly, Skuse, Mathisen, & Wolke, 1995). However, the development of this measure was subject to a multitude of problems, particularly relating to its norms. An informal measure, the Pre-Feeding Checklist, available within a clinical text book (Morris & Klein, 1987; 2000), and based on the Pre-Speech Assessment Scale (PSAS) (Morris, 1982, an unpublished manuscript), also has significant problems with its norms. Not surprisingly, oral sensorimotor skills and descriptions rated on the SOMA and Pre-Feeding Checklist differ, making reliable clinical assessment an impossible endeavor. These measures will be further elaborated in the literature review.

The purpose of this study was to establish a normative reference for oral sensorimotor skill development during the transitional feeding period. This study circumvents the shortfalls of previous work by studying age-stratified groups of young children in the transitional feeding period. The first phase of the project builds on previous work by compiling a comprehensive pool of oral sensorimotor skills identified from the literature for typically developing children. The project extends previous research by using expert validation procedures to determine the

importance and ease with which skills can be rated. In addition, the investigator developed operational definitions for each of the oral sensorimotor skills found to be both important and observable by experts. In the second phase of the project, data from 63 typically developing children (21 children in each of three age groups: 8, 10, and 12 months) were obtained and scored for the key oral sensorimotor skills identified in Phase I of the project. Results provide a foundation for advancing our understanding of clinical oral-motor development in young children. For the remainder of this document, oral sensorimotor skills will be referred to as oral-motor skills because the primary focus of this study was to quantify observable motor movements.

CHAPTER I: BACKGROUND AND LITERATURE REVIEW

Swallowing or deglutition includes the entire act from food placement in the mouth until the material enters into the stomach (Dodds, 1989; Dodds, Stewart, & Logemann, 1989; Logemann, 1998). Dodds and colleagues (1989) described the four phases of swallowing as the oral preparatory, oral, pharyngeal, and the esophageal phase. The oral preparatory phase is specific to anticipatory reactions, food getting, the placement of food in the mouth, and bolus management, including chewing, if necessary. The oral phase is specific to the transfer of the bolus with the tongue through the oral cavity into the pharynx. The pharyngeal phase begins with the initiation of the pharyngeal swallow and bolus movement through the pharynx. The esophageal phase begins with the movement of the bolus into the superior portion of the esophagus. Researchers stress that "feeding" is a broader function than swallowing (Arvedson & Brodsky, 2002; Logemann, 1998). The oral preparatory and oral phases of swallowing define the act of feeding. Literature regarding oral-motor skill development for feeding in young children in the transitional feeding period (aged 6– 12 months) is reviewed here.

Early oral-motor skill development

Both instrumental and descriptive studies of the development of oral-motor skills for feeding have been conducted across a wide span of ages, yet only a few studies in the literature have yielded normative data. As a result, a small and inadequate base of clinically relevant data for the transitional feeding period exists.

Instrumental studies of oral-motor skill development. Instrumental studies of oral-motor skill development for feeding have characterized aspects of strength, timing, and movement patterns of the normal oral mechanism that are difficult or impossible to ascertain through

observation with the naked eye. For example, studies have demonstrated that lip strength, chewing efficiency and jaw movement patterns vary by age and texture. Chigira, Kazuhiko, Mukai & Kaneko (1994) determined that midline lip pressure steadily increased from 5 months to 3 years of age (from 25 g/cm^2 stabilizing at approximately 75 g/cm^2), that no gender differences were present, and that variability decreased with age. Gisel (1991) determined that chewing duration and the number of cycles used to chew decreased with age, that solids took longer to chew than purees and that girls took more time to chew solids than boys. Wilson (2005) used kinematics to determine that infants produce unpredictable jaw movements during early chewing development, no age differences in range of jaw movement were detected for chewable foods, and that range of jaw movement increased with advances in textures. See Table 1 for sources yielding original instrumental data on oral-motor skill development during the transitional feeding period.

Table 1: Studies yielding original data for oral-motor skill development in typically-developing children during the transitional feeding period (6-12 months) using instrumental methods (*Same participants used by Gisel, 1991 and Stolovitz & Gisel, 1991; see Table 2)

Source	N	Method	Resulting normative data
(Chigira et al., 1994)	104 (5 months to 3 years	Midline lip pressure measurement using strain gauge embedded in spoon	Mean lip closing pressure on spoon
(Gisel, 1991)*	143 Age groups (mo): 6, 8, 10, 12, 18, 24	Cross-sectional clinical feeding observation Videorecording 10 trials of different textures (puree, small piece viscous, large piece viscous, solid)	Chewing duration, number chewing cycles, time/cycle ratios per textures; averaged across 10 trials
(Wilson, 2005)	48 Age groups (mo): 4, 7, 12, 35	Cross-sectional kinematic feeding assessment 5 trials of each food texture in child's current diet	Analyses of jaw: 3-dimensional volume 2-dimensional horizontal excursion Rate/frequency of chewing

While data obtained through instrumental methods provide important information regarding oral-motor skill development, the clinical relevance of these particular measures has not been shown and the relationship is not straightforward. Clinical studies involving observation of oral-motor skills have yielded information that is more readily generalized to clinical practice, but the research underlying existing literature is limited.

Observational and descriptive studies of oral-motor skill development. Descriptive studies of oral-motor skill development for feeding have identified and classified oral-motor skills. These oral-motor skills have been identified from direct observation by researchers and are often classified by texture (e.g., thin liquid, smooth puree, dissolvable solids, diced solids). No specific instrumentation is required for measurement by direct observation and these observations could occur in any environment (e.g., home, clinic, school). Collectively, observational studies have identified a general developmental progression of oral-motor and feeding skills occurring during the transitional feeding period (Carruth & Skinner, 2002; Gesell & Ilg, 1937; Morris, 1982; Stolovitz & Gisel, 1991). However, there are some inconsistencies across studies regarding the emergence of different oral-motor skills by age and texture. For example, Gesell and Ilg (1937) used a qualitative approach to gather information about the development of oral-motor skills from cinerecordings based on longitudinal observation of 10 typically developing children. Children were observed weekly from birth to six months and bi-weekly from six to 12 months. The authors identified four major feeding milestones during the transitional feeding period. These were: taking food from the spoon; handling thicker, lumpy foods and foods that require chewing; self-feeding with fingers or spoon; and cup drinking or managing the bottle on one's own or both. However, specific ages of skill mastery were primarily provided in three-month intervals and observation procedures were not standardized, but rather occurred during a natural mealtime. No reliability ratings of these observations were reported.

Morris (1982) also used a descriptive approach to gather information about the development of oral-motor skills from video-recordings based on longitudinal observation of six typically developing children. Demographic information was not provided for the six children.

These six children were observed monthly from birth to 12 months. A total of 63 oral-motor skills were described, although no methodology was presented to discuss how the information was gathered from the videotapes. Oral-motor skill categories were: sucking, swallowing, biting and chewing. There were 3-5 subcategories within each of these oral-motor skill categories. Morris (1982) reported the age at which each oral-motor skill was first observed (in at least one child) and the age at which two-thirds of the group (4 of 6 children) demonstrated each particular skill (defined as "mastery"). Appendix A has details regarding the minimum and maximum ages at which each oral-motor skill was mastered. One noteworthy finding from Morris' data is that the emergence for any oral-motor skill varied as much as 26 months across the six children. While specific ages of skill mastery were reported, observation procedures were not standardized, but rather occurred during a natural mealtime. Inter-rater reliability was calculated for 75 therapists who scored video samples of oral-motor skills during feeding. Specific information was not provided regarding the training to make these observations, the demographics of these 75 therapists participating in the reliability study, or reliability ratings for specific oral-motor skills. Percent agreement ranged from 65 to 87%.

In the largest study to date, Stolovitz and Gisel (1991) used a quantitative approach to gather information about the development of oral-motor skills from video recordings based on cross-sectional observations of 143 typically developing children. Six age groups were studied (6, 8, 10, 12, 18, 24 months). Children were between the 5th and 95th percentile for weight and head circumference, were without food allergies, and had at least two weeks experience eating solids. Five categories of oral-motor skills were studied: anticipation of food (four different descriptions of tongue position and movement with presentation of spoon), food removal (three different descriptions of type of lip movement on the spoon), reaction of food after removal of

spoon (three different descriptions of whether chewing was initiated or food was lost from mouth), frequency of tongue movements (four different descriptions of whether tongue movement was observed and type of movement), and swallowing (five different descriptions of type of lip closure). However, methodology was not described regarding how the target oral-motor skills were compiled for the study (with the exception of tongue movements, which were generated from a pilot study of five children per age group). Stolovitz and Gisel (1991) identified the number of times each target oral-motor skill occurred at each age by averaging the number of occurrences of each target skill across 10 feeding trials. Standard feeding procedures were described. Inter-rater reliability was calculated for two independent raters on all trials. An 80% agreement criterion was established for each scored category. Inter-rater reliability was 80% or above for the measures of anticipation of food and removal of food from the spoon but was below 80% for the other three measures of reaction to food after removal of spoon, frequency of tongue movements, and swallowing, suggesting that these oral-motor skills were difficult to rate.

Carruth and Skinner (2002) used a quantitative approach to gather information about the development of 11 oral-motor skills as related to gross and fine motor skills using a longitudinal parent report methodology on 98 typically developing children. Oral-motor skills studied originated from Morris (1985; 1991). Using an incomplete block design, mothers were interviewed five to six times at nine different possible ages of their infants between 2-24 months of age. The mothers reported the age at which their child began to perform any of the 11 different oral-motor skills. Emergence of reported oral-motor skills varied as little as 5.5 months and as much as 13.5 months for any given skill (Carruth and Skinner, 2002). Table 2 provides a summary of sources yielding original observational data on oral-motor skill development during the transitional feeding period.

Table 2: Studies yielding original data for oral-motor skill development in typically-developing children during the transitional feeding period (6-12 months) using observational methods and descriptions (*Same participants for Stolovitz & Gisel, 1991 and Gisel, 1991; see Table 1)

Source	N	Method	Resulting normative data
(Carruth & Skinner, 2002)	98; 2-24 months	Longitudinal parent interview; 5-6 interviews at 9 different possible infant ages	Onset of particular oral-motor; fine motor and gross motor skills
(Gesell & Ilg, 1937)	10; Birth to 12 months	Longitudinal clinical feeding observation; Cinerecording No standardized feeding procedures	Descriptions of oral-motor behaviors
(Morris, 1982)	6; Birth to 36 months	Longitudinal clinical feeding observation; Videorecording No standardized feeding procedures	Descriptions of oral-motor behaviors
(Stolovitz & Gisel, 1991)*	143 Age groups (mo): 6, 8, 10, 12, 18, 24	Cross-sectional clinical feeding observation Videorecording 10 trials of different textures (puree, small piece viscous, large piece viscous, solid)	Frequency of occurrence anticipation of food, food removal with lips, reaction after spoon removal, tongue movements; swallowing; averaged across 10 trials

In summary, original data on the development of oral-motor skills for feeding were gathered with relatively small sample sizes (Gesell & Ilg, 1937; Morris, 1982), different feeding procedures (Carruth & Skinner, 2002; Gesell & Ilg, 1937; Morris, 1982; Stolovitz & Gisel, 1991), different numbers and types of oral-motor skills (Carruth & Skinner, 2002; Gesell & Ilg,

1937; Morris, 1982; Stolovitz & Gisel, 1991), inconsistent inter- and intra-rater reliability ratings (Morris, 1982; Stolovitz & Gisel, 1991) or no reliability ratings (Carruth & Skinner, 2002; Gesell & Ilg, 1937). These problems limit comparisons across studies and result in varying reports of expected oral-motor skill development for feeding during the transitional feeding period.

Of note, several interesting variables were identified during review of these studies. Morris (1982) was the first and only researcher to address the concept of both emergence and mastery of oral-motor skills for feeding. Publications by Morris and Klein (1987; 2000), which have expanded on the original research by Morris (1982), have provided the foundation for many chapters, reviews and developmental checklists (see Alexander, Boehme, & Cupps, 1993; Arvedson & Brodsky, 2002; Bosma, 1986; Carruth & Skinner, 2002; Pinder & Faherty, 1999; Pridham, 1990; Reilly et al., 1995; Rogers & Arvedson, 2005; Stevenson & Allaire, 1991). Stolovitz & Gisel (1991) were the first authors to analyze oral-motor skills by temporal sequence of the feeding process (i.e., anticipation of food as the spoon approaches the mouth, the initiation of chewing, and swallowing) rather than texture alone. Carruth and Skinner (2002) were the first authors to compare general motor skills with oral-motor skills, setting the stage for a more global perspective of motor development. Consideration of these variables within one project would provide unique information about oral-motor skill development for feeding.

Existing clinical tools for oral-motor and feeding skills assessment

Purpose of clinical feeding assessment. Clinical feeding assessment (observation of oral-motor skills during a feeding) is the primary method used by clinicians to assess the oral mechanism and oral-motor skills for feeding and swallowing. Clinical feeding assessments are used to identify differences in oral-motor skill development that may be associated with dysphagia (swallowing problems). Clinical feeding assessment is also used to identify problems

such as coughing and choking that may suggest aspiration into the lungs resulting from weakness, incoordination, altered sensory processing, or neurological impairment that may delay or inhibit the transition to advanced food textures. Such difficulties may require diet modification and supplementation of nutrients by temporary or permanent feeding tubes for pulmonary health, growth, and development. Identification of appropriate medical and therapeutic management requires a thorough understanding of the complexities of the developing oral-motor mechanism in order to determine if oral-motor skill differences are contributing factors to a child's feeding problems, if the child is able to safely eat orally, and what food textures are appropriate for the child's abilities. However, normative data on oral-motor skill development for feeding do not currently provide an adequate evidence-base for clinical decision making. Comprehensive normative information is essential for ensuring that appropriate medical and clinical decisions are being made in the treatment of children with feeding and swallowing differences, delays, and disorders.

Assessment tools have been devised to document oral-motor skill functioning for feeding. However, most of these measures are based on data from older children for the assessment of children with neurological deficits (Kenny et al., 1989; Stratton, 1981). Informal checklists are the primary method of evaluation for younger children. Two measures exist for children in the transitional feeding period, but both measures have significant weaknesses.

Pre-Feeding Checklist based on the Pre-Speech Assessment Scale. The Pre-Feeding Checklist, an informal clinical feeding measure was published in a textbook by Morris and Klein (1987; 2000) The checklist was based on the PSAS (Morris, 1982; an unpublished manuscript) and is one popular tool for early feeding assessment. The Pre-Feeding Checklist is divided into feeding categories (i.e., Sucking: sucking liquids from breast or bottle, sucking liquids from a

cup, sucking soft solids from a spoon; Swallowing: swallowing liquids, swallowing semi-solids, swallowing solids, coordination of sucking, swallowing, and breathing; Biting and Chewing: jaw movements in chewing, tongue movements in chewing, lip movements in chewing). Each feeding category contains a variable number of notable oral-motor skills by age to be rated during a mealtime observation. Observations with a variety of textures are needed but no standardized feeding procedures are required. The administrator determines whether the oral-motor skills observed are "present" or "not present." Scoring is accomplished by determining the age the child's skill most resembles for each feeding category. Appendix B lists feeding categories and expected oral-motor skills by age described by Morris (1982).

The Schedule for Oral Motor Assessment. The Schedule for Oral Motor Assessment (SOMA) (Reilly et al., 1995) is the only standardized feeding measure available for the transitional feeding period (available to use with children between 8-24 months of age) but is not widely used clinically. The authors developed the measure by compiling a list of oral-motor skills for feeding found in the literature and from their clinical experience, including normal and abnormal oral-motor skills. The authors did not provide references to indicate where they obtained their list of oral-motor skills. The compiled oral-motor skills were categorized by texture (i.e., puree, semi-solid, solid, and cracker) and methods of drinking (i.e., bottle, trainer cup, and cup) and were used to score videotaped feedings of children. The authors used a relatively large number of children (58 typically developing children [x=12.2 months (range 8-21.2 months)]; 56 children with non-organic failure to thrive [x=15 months (range 8.75-19.5 months)]; 13 children with cerebral palsy [x=20.2 months (range 14.2-44 months)]) between the ages of 8-44 months (Reilly et al., 1995). Two sets of ratings were completed. The first rating judged whether the skill in question could be clearly evaluated (for that particular child) (Reilly

et al. 1995). For each child, skills were omitted if the child refused the presentation or if the skill could not be clearly evaluated due to technical or administration error. Of those oral-motor skills that could be evaluated, a second rating was completed to determine if each skill was present or absent and thus whether the child had a passed or failed response based on developmental level (e.g., a passed response would suggest the expected presence of the skill based on the developmental level of the child). Existing literature was used to determine whether the presence or absence of the oral-motor skill was normal for each child. If the available literature did not specify whether the oral-motor skill was normal based on the child's developmental level, the authors used their clinical judgment to determine the status of the skill. Inter-rater reliability was calculated for a random selection of ten videotapes of the typically developing children (n=3) and children with non-organic failure to thrive (n=7). Two independent raters participated after receiving detailed training in administration and scoring. For liquids, adequate reliability (i.e., kappa values greater than 0.75) was established for 77% of relevant oral-motor skills. For all other textures combined (i.e., puree, semi-solid, solid, cracker), adequate reliability was established for only 62% of relevant oral-motor skills. Overall, data from the sample were not stratified by age and since children with disabilities were included in the sample, normative data for typically developing children are difficult to glean.

In spite of significant problems with the norming sample, the SOMA provides detailed instructions for a standard feeding procedure with standard textures, utensils, and presentation (Reilly, Skuse, & Wolke, 2000). Seven texture categories are scored for each child. Each texture category (i.e., puree, semi-solid, solid, cracker, bottle, trainer cup, and cup) contains a variable number of oral-motor skills upon which each child is scored. Operational definitions are provided for each oral-motor skill. Children are rated as having normal or abnormal oral-motor

skills across a number of items using an indicator of "present" or "absent" for each oral-motor skill. Children receive a score of 'normal oral-motor function' or 'oral-motor dysfunction' for each texture category (for a potential total of seven scores). All children, regardless of age, are scored on the same skills without adjustment for age, suggesting that children between 8-24 months are expected to demonstrate the same oral-motor skills. No standard score is given relative to age to determine how different skills are from age expectations. Appendix C shows SOMA texture categories and related oral-motor skills.

Summary of existing assessment tools. Overall, neither the Pre-Feeding Checklist nor the SOMA provides evidence-based normative information satisfactory to make difficult clinical decisions regarding a young child's feeding. These measures use different skills and different oral-motor descriptions. The Pre-Feeding Checklist uses descriptive norms based on a very limited sample of children, making the variability in age of skill mastery inadequate for evidence-based decisions. The SOMA lacks stratification by age in its normative sample and it does not adjust scoring for age, leading to the assumption that children 8-24 months of age should demonstrate the same oral-motor skills for feeding. This assumption is inappropriate and not justified by the authors. Clearly, normative and standardized data are needed to further the understanding of oral-motor skill development for feeding and to serve as a foundation for an evidence base that is relevant to clinical practice.

Problems with current descriptions of oral-motor skill development for feeding

Many different descriptions of oral-motor skills for feeding are found in the literature. (Table 3).

Table: 3. General overview of oral-motor skills reported during feeding development

Age	Oral-motor skills	Reference
4-6 months		
4-5	Opens mouth when spoon approaches or touches lips	1
4-5	Tongue moves gently back and forth as food enters mouth	1
4-5	Tongue used to move food to back of mouth to swallow	1
5	Suckles pureed food from spoon	3
5	*Up and down jaw movements described as munching*	3
5-7	Learns to get semisolid food from spoon	2
5-12	*Small changes in shifting and rolling the tongue*	3
6-8 months		
6	*Begins a munching type of up-and-down movement of jaw*	2
6	Begin to "gum" thicker food with small lumps	2
6	*Upper lip begins to move downward to clean spoon*	3
6	Uses tongue and mouth to explore shapes and textures of toys	1
6-8	Keeps food in mouth and is not re-fed	1
6-8	Sucks from cup, tongue projects before swallowing and milk leaks from corner of mouth	2
7	*Begin to chew in a rotary, more adultlike manner (continues to develop through the next 5 months)*	2
7-8	*Brings top lip down on spoon to remove food*	1
7-8	Begins to take one or two swallows from cup held by parent	2
7-8	Chokes easily when drinking from cup	2
7-9	Most infants can be given liquids by cup; most have mouth closure around the cup rim	4
8-10 months		
8	Can quickly and efficiently remove food from spoon using both upper and lower lips	2
8	Brings head forward to accept the spoon	2
8	*Increasing flexibility to move tongue flexibly, including laterally (can now be introduced to soft mashed foods with lumpy texture)*	
8-10	Eats food with tiny lumps without gagging	1
8-10	Chews softer foods; keeps most in mouth	1
9	Up and down tongue movement during swallow of purees	3
9-10	Most infants can drink from cup held for them	2

Table: 3. (cont.) General overview of oral-motor skills reported during feeding development

Age	Oral-motor skills	Reference
10-12 months		
10	Can manipulate food with definite chewing movements	2
10-12	Chews firmer foods; keeps most in mouth	1
12	*Chewing appears with up-down and diagonal rotary movements*	4
12	*Appearance of tongue lateralization*	4
12	Chews and swallows firmer foods without choking	1
12	Can take controlled bites of soft solids or readily dissolved crunchy foods	2
12	Most infants can hold cup with two hands and take four or five more swallows continuously without choking	2
12	*Tongue begins to shift food to cutting edge of teeth*	3
12	*Jaw movements gain rotary component*	3
12	Mature swallow with tongue tip elevation	3
12	Corners of lips actively draw inward to help move food	3
>12 months		
15	Chews foods that produce juice	1
24	*Controlled rotary jaw movements*	3
24	*Tongue lateralization*	3

References: (Sources)
1.) Carruth & Skinner (2002) (Original data by parent report; oral-motor skills came from Morris, 1985; 1991)
2). Pridham (1990) (review of Gesell & Ilg, 1937)
3). Stevenson & Allaire (1991) (Bosma, 1986; Gisel, 1991; Illingworth & Lister, 1964; Morris, 1982; Morris & Klein, 1987)
4). Rogers and Arvedson (2005) (Arvedson & Brodsky, 2002; adapted table from Carruth & Skinner, 2002)
Items in italics are noted in more than one age range.

The number of different oral-motor skills reported in the literature has likely become inflated as each researcher has provided an independent account of the same oral-motor skills using different terminology due to the lack of standardization. Wide age ranges of skill mastery for individual oral-motor skills (varying between 5.5 and 26 months across studies) are reported (Carruth & Skinner, 2002; Morris, 1982) making it impossible to ascertain the age at which oral-motor skills are expected during feeding development. It is difficult to know if such variability is real or is an artifact of interpretation / terminology differences among studies. Because of this

lack of standardization, there are several key problems with current descriptions of oral-motor skills for feeding. Key problems are: inconsistent methodology to determine emergence or mastery of skills; descriptions of global feeding behaviors rather than individual oral-motor movements; subjective descriptions with different operational definitions; and inconsistent categorization of skills. Each of these problems is elaborated below.

Inconsistent methodology to determine emergence or mastery of skills. The first key problem with interpreting the existing literature on oral-motor skill development is the inconsistent methodology used to determine emergence or mastery of oral-motor skills. Although Morris (1982) presented data on the emergence and mastery of individual oral-motor skills, designation of "mastery" was based on data that were pooled across only six children. In addition, some descriptions, as noted in Table 3, focus on comparisons to the mature oral-motor system (e.g., begins to chew in a rotary, more adult-like pattern; mature swallow with tongue tip elevation). Other authors describe oral-motor skills as emerging (e.g., begins a munching type of up-and-down movement of jaw; begins to "gum" thicker food with small lumps; appearance of tongue lateralization) or as mastered (e.g., keeps food in mouth, no re-feeding; can manipulate food with definite chewing movements). In addition, duration of experience (i.e., exposure to textures) is likely an important consideration for emergence or mastery of oral-motor skill development because the timing of the introduction of textures may be variable across children. However, none of the published articles known to this author have controlled for experience, which may have increased the variability in reported emergence or mastery of skills. A definitive method to determine emergence and mastery of an oral-motor behavior should alleviate many of these issues.

Descriptions of global feeding behaviors rather than individual oral-motor movements. A second key problem is that descriptions of oral-motor skills (as noted in Table 3) do not consistently portray actual oral-motor skills, but rather description of "milestones" or global feeding behaviors (e.g., learns to get semi-solid from spoon; eats finger food without gagging) that encompass multiple oral-motor movements. Oral-motor skills are difficult to rate when descriptions combine multiple movements into one observation and crucial changes in individual movements may be missed (e.g., external jaw stabilization defined as "the child cannot stabilize the jaw and needs to bite on the spoon or cup to provide this stability; jaw excursions are often wide and the lips and tongue move in unison with the mandible; liquid and food loss may be considerable). One or more of these movements may be affected and judging all movements together will not identify the source of the feeding problem. As well, oral-motor skills must be observable rather than requiring assumptions about variables that require instrumentation for true measurement (e.g., controlled, sustained bite defined as "…strength is adjusted to suit the hardness of the biscuit"; Reilly et al., 2000, p. 19). Strength cannot be quantified by direct observation. Individual movements of an oral-motor skill may emerge or are mastered at different times during development. Taking each aspect of the oral-motor skill and judging movements individually may reduce complications of performance variability, increase consistency of observations, and thus reduce the range of the age of skill mastery reported in the literature.

Subjective descriptions with different operational definitions. A third key problem is that many descriptions of oral-motor skills use highly subjective terms and differing operational definitions. Descriptions of oral-motor skills that include ambiguous adjectives (e.g. quickly, efficiently, controlled, graded, symmetric, smooth, active, effortless, and coordinated) require

interpretation. Use of such subjective descriptors likely contributes to the variability in reported age of skill mastery and consistency of observations by researchers and clinicians. Other descriptions (e.g., can manipulate food with definite chewing movements) require subjective interpretation because the actual movement is difficult to discern. In addition, lack of standard terminology for descriptions of oral-motor skills presents a similar problem with subjective interpretation during data collection, and with comparing data across studies. For example, different descriptors for "opens mouth for spoon" include "opens mouth when spoon approaches; graded jaw opening to accept spoon; opening mouth in anticipation". In addition, different operational definitions for similar oral-motor skill descriptions complicate ratings. Examples are excerpted below.

Internal jaw stabilization (PSAS): The lack of observable up-and-down movement of the jaw during drinking which occurs as the child bites down on the edge of the cup. When the cup is placed between the lips, the child may revert to the up-and-down movements of the jaw. Liquid intake is achieved through action of the tongue and lips (Morris, 1982, p. 70).

Internal jaw stabilization (SOMA): External stabilization is not required. The child can separate lip and tongue movements from the mandible, which now moves independently and there is no longer any need to bite down on the spoon to stabilize the jaw. There is little liquid loss during drinking or food loss during eating, as the lips and tongue now exhibit a more mature degree of control. There are much reduced vertical mandibular movements (Reilly et al., 2000, p. 12).

Controlled sustained bite (PSAS): The child's teeth should close on the food, biting through it gradually. This is followed by an easy release of the food for chewing. The jaw does not snap closed suddenly on the food. Observed whether the child actually bites through the food or whether he or she simply holds it while the person doing feeding breaks it off into his or her mouth (Morris, 1982, p. 92).

Controlled sustained bite (SOMA): Functional well-controlled bite on variations in materials, that is hard or soft biscuits. The strength of the bite is adequate to break pieces off. Strength is adjusted to suit the hardness of the biscuit (Reilly et al., 2000, p. 19).

Jaw grading (PSAS): The ability to vary the opening of the mouth in small amounts that are appropriate for biting food of different thicknesses. This is developed as a type of visual orientating response based on the child's visual ability to recall the kinesthetic feedback from opening the mouth for various sizes or thicknesses of food (Morris, 1982, p. 92).

Jaw grading (SOMA): The child is able to grade different sized openings of the jaw to accept a variety of thicknesses of biscuit, etc. The jaw opening is neither too wide nor too narrow (Reilly et al., 2000, p. 19).

Determination of the similarities and differences in descriptions of oral-motor skills can help reduce the overall number of required observations and aid in the standardization process.

Inconsistent categorization of skills. Another key reason why there are many different descriptions is because of the lack of consistent categorization of oral-motor skills. Oral-motor skills are primarily described in the literature on the basis of texture. Categorizing all oral-motor skills by texture assumes that oral-motor skills for feeding are texture-specific which increases the number of required observations. While there are some oral-motor skills that occur specific to texture (i.e., biting a solid), it is very likely that many similar skills occur regardless of texture. Other classification strategies used to describe oral-motor skills include function of oral structure (e.g., jaw movement in biting, tongue movement in chewing), method of delivery of the bolus (e.g., spoon, finger, sipper cup, open cup) and feeding process (e.g., anticipation of food, initiation of chewing, and swallowing). Because different classification systems are used to describe or measure oral-motor skill development, the number and type of observations required are overwhelming.

Proposed classification for oral-motor skill development

The adult literature describing oral-motor skills has focused on the function of the important oral structures for the feeding and swallowing process (Dodds, 1989; Dodds et al., 1989; Hiiemae & Palmer, 2003; Kennedy & Kent, 1985; Logemann, 1998). Descriptions of oral-motor skills using this classification strategy acknowledge anatomic, physiologic, and functional components of the feeding process (Table 4).

Table 4: Function of important oral structures involved in feeding

Structure	Function/Importance
Jaw	Supports and positions tongue and lips
	Opens and closes to accept and chew food
Lips	Open to accept food
	Close to contain food and prevent anterior food loss
	Retrieval of food outside oral cavity
Tongue	Cups around bolus to control inside oral cavity
	Repositions and changes shape to manipulate bolus
	Retrieval of food outside oral cavity
	Moves upward to contact hard palate to propel bolus into pharynx

References: (Dodds, 1989; Dodds et al., 1989; Hiiemae & Palmer, 2003; Kennedy & Kent, 1985; Logemann, 1998)

Researchers in adult swallowing have alleviated classification differences by categorizing swallowing physiology by phase (i.e., oral preparatory, oral, pharyngeal and esophageal phases) (Dodds, 1989; Dodds et al., 1989; Logemann, 1998) instead of texture alone. This type of classification organizes oral-motor skills by the sequence of physiologic events. Although swallowing includes the entire act from food placement in the mouth until the material enters into the stomach (Dodds, 1989; Dodds et al., 1989; Logemann, 1998), as previously described, the feeding process consists of the first two phases of swallowing, described as the oral preparatory and oral phases. Direct observation is possible for skills related to these two phases. This type of classification and organization has not been consistently applied to any pediatric feeding measure.

Identification of specific oral-motor skill deficits is essential for diagnosis of and intervention for feeding problems in children. A solid evidence base is a crucial foundation for clinical practice related to feeding in children. The current lack of standardization in methodology, limited sampling and inconsistent and subjective descriptions of oral-motor skill

development for feeding is problematic as these data provide the basis for major medical and treatment decisions about children with disordered feeding ability. Comparisons across studies, across clinicians and across assessment periods are inhibited by these limitations. Adapting the adult classifications of oral structure function and swallowing phase to oral-motor skill development in infants and young children would allow for a thorough evaluation across multiple variables of feeding (Logeman, 1998; Arvedson & Lefton-Greif, 1998).

Purpose of the present study

This review highlights the need for robust and standard descriptions of an age-specific developmental sequence of oral-motor skills for feeding for children in the transitional feeding period. The goal of the present study was to identify a core set of oral-motor skills that reflect existing literature and are validated based on expert opinion. The study also sought to identify the age at which the core set of oral-motor skills are expected to develop. This information will permit preliminary normative comparisons between typically developing children and children being assessed for feeding problems, forming the foundation for an evidence base.

Two phases of this project address the following questions: 1.) What are the observable and important oral-motor skills that characterize the transitional feeding period; and, 2.) Can age and experience differences among children be detected via clinical assessment of the presence or absence of the oral motor skills identified as both important and observable?

The first phase of this project used the existing literature to identify oral-motor skills that were observable and important as validated by experts. Oral-motor skills were then compiled into a comprehensive list and organized by function of oral structures to determine how many different oral-motor skills exist for feeding. By collapsing redundant oral-motor skills, a core set

of skills remained that can be readily scored by direct clinical observation. This set of standard descriptions of oral-motor skills for feeding and their associated operational definitions were organized into a unique measure that was utilized for the second phase of this project.

The second phase of the project employed standard feeding procedures including use of consistent textures, utensils, and feeding presentation. The target oral-motor skills identified in the first phase of the study were then scored and differences among children based on their chronological age and experience were evaluated for five separate textures. Analyses also sought to identify which skills were performed at mastery-level by texture, age, and experience. This methodology extends the current descriptive work in the literature by providing a standard set of observable and objective descriptions used to identify the mastery of targeted oral-motor skills.

CHAPTER II: RESEARCH DESIGN AND METHODS

Phase I

Goal of pilot study. The goal of this pilot study was to identify a comprehensive list of oral-motor skills from the literature and then to narrow the list to those oral-motor skills that could be scored by direct observation and were deemed important by experts. An electronic literature search was used to identify all candidate sources describing normal oral-motor skill development for feeding during the transitional feeding period. The electronic search was conducted using keywords (i.e., chewing, chewing development, feeding assessment, normal feeding development, normal oral motor development, oral motor, oral motor assessment, oral motor development), with advanced search criteria including "all article types, infants 1-23 months, human, all years". The following databases were used for the electronic search: Pubmed, ERIC, Psychlit, and CINAHL. To be included in the comprehensive listing of oral-motor skills, inclusion criteria required that each source: 1.) be a peer-reviewed article describing original research; 2.) provide descriptions of oral-motor skills observed during feeding in typically developing children between 6 and 12 months of age; and 3.) describe oral-motor skills related to solids and liquids by cup or straw. Studies excluded from the review were those that identified oral-motor skills that were: 1.) related to neurological impairment; 2.) based on instrumental or timing measures (e.g. videofluoroscopic swallowing evaluations, EMG, kinematic measurement, chewing duration measures, or reflexes); and 3.) related to bottle-feeding or nursing only (as these were not defined as transitional skills for the purposes of this study).

Results of literature search. Results revealed that only one article met all criteria (Stolovitz and Gisel, 1991). Therefore, inclusion criteria were expanded to include review articles, parent-report research, and articles describing instrument design / development for the transitional feeding period. Six articles met the expanded inclusion criteria. Review articles (Pridham, 1990; Rogers and Arvedson, 2005; Stevenson and Allaire, 1991); parent reported onset of feeding behaviors (Carruth and Skinner, 2002); and methods and validation for standardized feeding measures were identified (Reilly et al., 1995; Skuse, Stevenson, Reilly, & Mathisen, 1995).

Ancestral searches were performed on the review articles and the parent report article in an attempt to identify additional studies that met inclusion criteria. Results revealed that the majority of normative oral-motor data referenced in the literature on children ages 6-12 months originated from Morris (1982) and were published as the Pre-Feeding Checklist within clinical reference books by Morris and Klein (1987; 2000). The original source of the normative data, Morris (1982), describes the Pre-Speech Assessment Scale (PSAS), the informal feeding assessment tool for transitional feeders, which was developed based on longitudinal observation of six children. Although the original research describing development of the PSAS was not published in a peer-reviewed journal, Morris (1982) describes the methodology for obtaining the reported normative data, age of emergence, and mastery of oral-motor skills, and the resultant assessment scale. Because Morris' work on the PSAS and her subsequent reporting of the normative data from the PSAS in clinical texts (Morris & Klein, 1987; 2000) are widely referenced, this source was included in the compilation of oral-motor skills. The manual for the Schedule for Oral Motor Assessment (SOMA) (Reilly et al., 2000) based on associated articles (Reilly, et al., 1995; Skuse et al., 1995) was also included in the compilation of oral-motor skills.

Given the limited number of studies for the transitional feeding period, lists of oral-motor skills were also collected from two other studies found in the ancestral search (Kenny et al., 1989; Kumin & Bahr, 1999). These studies were not located during the initial literature search because they were based on expected oral-motor skills for older typically developing children and data on children with disorders. The compilation included oral-motor skills reported during normal oral-motor development for children older than 12 months of age because there: 1.) were limited sources found for children aged 6-12 months; and 2.) was a high level of variability in reported age of oral-motor skill mastery. Use of these studies helped to provide a more comprehensive list of oral-motor and feeding skills based on the mature oral-motor system to be used as comparison to the developing system.

The compilation from the identified sources included oral-motor skills if the skill: 1.) was ratable by direct observation; 2.) was reported as normally occurring during development; 3.) was based on solids or liquids by cup or straw. The compilation from the identified sources excluded oral-motor skills if the skill: 1.) required instruments to measure (e.g. videofluoroscopic swallowing evaluations, EMG, kinematic measurement, chewing duration measures or reflexes); 2.) was observed only in children with neurological impairment; 3.) described feeding problems (e.g., cough, choke); 4.) was based on bottle-feeding or nursing; or 5.) was a duplicate within a combined texture category for an individual source (e.g., oral-motor skills specific to both puree and semi-solid textures; crackers and solids; cup and straw). The oral motor skills were listed by the corresponding texture (i.e., purees, solids, liquids) because this classification is most frequently noted in the literature and to guarantee that the list included all oral-motor skills expected for all textures. Purees and semi-solids were collapsed into one category of purees to indicate foods offered from spoon. A total of 148 oral-motor skills were

compiled from the literature using sources that provided either original data and / or a comprehensive list of expected oral-motor skills for typically developing children (Kenny et al., 1989; Kumin & Bahr, 1999; Morris, 1982; Reilly et al., 1995; Stolovitz & Gisel, 1991). Twenty-seven oral-motor skills that were mutually exclusive from those found in the literature were added based on the expert clinical opinion of the author; however, expected age of mastery was not specified for these additional oral-motor skills. A total of 175 oral-motor skills were included in the final comprehensive list.

The 175 oral-motor skills representing oral-motor development for feeding. The number and percentage of the 175 original oral-motor skills by texture, function, and source were identified. By texture, 74 (42%) of the skills were specific to foods offered from a spoon, including pureed and semi-solid textures; 68 (39%) of the skills were specific to crackers or solids requiring chewing; and 33 (19%) of the skills were specific to liquids (trainer cup, open cup or straw).

Oral-motor skills were also organized according to the function that they served. A total of 16 different functions were identified based on the literature on oral function, sequence of physiologic event, and by examining the listing of 175 oral-motor skills for similarities among behaviors. For example, the oral-motor skill, upper lip contacts spoon, describes the function of lip closure on an object or "lip closure-object". Functions and operational definitions are presented in Table 5.

Table 5: Definitions for the 16 functions of oral structures used to classify the 175 oral-motor skills.

Function	Operational definition
1. # of sips and swallows	one sip and swallow versus multiple sips and swallows
2. Awareness	motor action demonstrating awareness of food presentation
3. Biting	breaking off a piece of solid from a whole with teeth or gums
4. Cheek activity	use of cheeks during bolus manipulation
5. Chewing	type of jaw movement used to manipulate a solid
6. Coordination	timing of initiation of bolus movement through the swallow
7. Jaw closure	maintenance of jaw with certain amount of closure
8. Jaw movement	amount and pattern of a series of movements of the jaw
9. Jaw opening	amount and type of opening of the jaw
10. Lip closure-manipulation	lip position while manipulating the bolus
11. Lip closure-object	lip position to touch spoon, solid, or cup
12. Lip closure-swallow	lip position during swallowing
13. Maintenance	ability to maintain the bolus within the oral cavity
14. Retrieval	retrieval of food lost from oral cavity
15. Tongue movement	type of movement of the tongue
16. Tongue position	location of the tongue

By function, there were 7 descriptions (4% of total skills) of # of sips/swallows, 10 descriptions (6%) of awareness, 13 descriptions (7%) of biting, 1 description (0.5%) of cheek activity, 7 descriptions (4%) of chewing, 5 descriptions (3%) of coordination, 7 descriptions (4%) of jaw closure, 7 descriptions (4%) of jaw movement, 11 descriptions (6%) of jaw opening, 8 descriptions (5%) of lip closure-manipulation, 22 descriptions (13%) of lip closure-object, 9 descriptions (5%) of lip closure-swallow, 8 descriptions (5%) of maintenance, 11 descriptions (6%) of retrieval, 31 descriptions (18%) of tongue movement, and 13 descriptions (7%) of tongue position. Five descriptions did not fall clearly into one individual function (other; 2.5%).

By source, 46 (26%) of the skills were from Morris (1982), 21 (12%) of the skills were from Kenny and colleagues (1989), 19 (11%) of the skills were from Stolovitz and Gisel (1991), 30 (17%) of the skills were from Reilly and colleagues (1995), 32 (18%) of the skills were from Kumin and Bahr (1999), and 27 (15%) of the skills were from expert opinion. See Appendix D for complete list of 175 oral-motor skills by texture, function, and source.

Expert validation of oral-motor skills. Ten speech-language pathologists (SLP), working in an inpatient and / or outpatient pediatric medical setting, independently rated each oral-motor skill as organized by texture based on whether or not it could be observed or scored clinically. Three SLPs worked exclusively in feeding / swallowing, two had experience identifying oral-motor / feeding problems but would refer to another SLP for evaluation and treatment, and the remaining SLPs all worked specifically with patients with feeding / swallowing disorders in addition to other general areas of speech and language pathology (e.g., cognition, speech/language, voice). The SLPs had an average of 12.5 years of experience (range 3-33). SLPs made binomial ratings (i.e. “yes” or “no”) for each of the 175 oral-motor skills in response to the question “Is this oral-motor skill readily and visibly observable during a routine feeding

evaluation?" (hereafter referred to as scorable oral-motor skill). "Yes" ratings were coded as "1" and "no" ratings were coded as "0". Ratings for each oral-motor skill were summed across all judges. Oral-motor skills that at least 8 of 10 judges (80% or more) identified as scorable were of interest for this study. Sixty-seven of the 175 oral-motor skills met this criterion. To determine intra-judge reliability, the same SLPs were asked to rate the oral-motor skills a second time three months later. Of the 67 oral-motor skills that were identified initially as scorable, 63 met the 80% criteria on the second round of ratings, resulting in intra-judge agreement of 94% (agreement / agreements + disagreements). The final set of 67 oral-motor skills are those that experts agree can be observed well enough to score during a feeding observation. These skills are shown in Appendix E.

To determine how well the 67 skills identified by SLPs with expertise in feeding represented the original 175 oral-motor skills compiled from the literature, the number and percentage of skills by texture, oral function and source were identified. Descriptive data are presented in Tables 6, 7, and 8. Results suggest that the 67 skills identified as "scorable" by experts were representative of the original 175 skills.

Table 6: The number (percent) of the 175 original oral-motor skills and 67 scorable oral-motor skills classified by texture

Texture	Number (%) of 175 original	Number (%) of 67 scorable
Puree	74 (42%)	31 (46%)
Solids	68 (39%)	24 (36%)
Liquids	33 (19%)	12 (18%)

Table 7: The number (percent) of the 175 original oral-motor skills and 67 scorable oral-motor skills classified by function of oral structures.

Function	Number (%) of 175 original	Number (%) of 67 scorable
1. # of sips and swallows	7 (4%)	3 (4.4%)
2. Awareness	10 (6%)	6 (9%)
3. Biting	13 (7%)	6 (9%)
4. Cheek activity	1 (0.5%)	0 (0%)
5. Chewing	7 (4%)	1 (1.4%)
6. Coordination	5 (3%)	0 (0%)
7. Jaw closure	7 (4%)	0 (0%)
8. Jaw movement	7 (4%)	3 (4.4%)
9. Jaw opening	11 (6%)	3 (4.4%)
10. Lip closure-manipulation	8 (5%)	3 (4.4%)
11. Lip closure-object[1]	22 (13%)	12 (18%)
12. Lip closure-swallow	9 (5%)	6 (9%)
13. Maintenance	8 (5%)	8 (12%)
14. Retrieval	11 (6%)	7 (10.4%)
15. Tongue movement[2]	31 (18%)	2 (3%)

[1] Lip closure-object, maintenance, and retrieval all had a higher percentage of oral-motor skills judged as scorable. One likely explanation includes that these functions occur at the lips or outside of the oral cavity, clearly visible by direct observation.

[2] It is noteworthy that the experts judged a lower percentage of oral-motor skills that described, "tongue movement" as scorable. There are several possible explanations including that the descriptions were written in a way to make it difficult to judge; tongue movements are complex and difficult to describe; and / or that tongue movements are difficult to judge because often the lips are closed.

Table 7 (cont.): The number (percent) of the 175 original oral-motor skills and 67 scorable oral-motor skills classified by function of oral structures.

Function	Number (%) of 175 original	Number (%) of 67 scorable
16. Tongue position	13 (7%)	4 (6%)
Other	5 (2.5%)	3 (4.4%)

Nearly 60% of the scorable oral-motor skills came from two sources (Kumin & Bahr, 1999; expert opinion). Only 14% of the scorable oral-motor skills came from the available feeding measures for the transitional feeding period (Morris, 1982 (PSAS); Reilly et al., 1995 (SOMA)). These findings suggest that the skills described in the PSAS or the SOMA may not be readily scorable, even to expert clinicians. See Table 8 for source specific information.

Table 8: The number (percent) of the 175 original oral-motor skills and 67 scorable oral-motor skills classified by source

Source	Number (%) of 175 original	Number (%) of 67 scorable
Morris (1982) (PSAS)	46 (26%)	8 (12%)
Kenny et al. (1989)	21 (12%)	9 (13%)
Stolovitz & Gisel (1991)	19 (11%)	4 (6%)
Reilly et al. (1995) (SOMA)	30 (17%)	6 (9%)
Kumin & Bahr (1999)	32 (18%)	17 (25%)
Expert opinion	27 (15%)	23 (34%)

After the list of 67 scorable oral-motor skills was compiled, skills were further examined in order to identify and reduce potential redundancies. To do this, the 67 skills were organized by the 16 function of oral structure categories and were reviewed to identify the following: 1.) texture-specific terms (e.g., spoon, cup, straw, food, solid); and 2.) multiple movements described as one skill (e.g., sucking and swallowing of liquids from a cup).

Reduction of redundant oral-motor skill descriptions. With regard to use of texture-specific terms, oral-motor skills describing similar movements with texture-specific terms as the only difference were combined into one skill. For example, "keeps lips closed while swallowing liquids" and "keeps lips closed while swallowing solids" were combined into "keeps lips closed while swallowing". Another example: "lips close on food", "forms lip seal on cup", "adequate lip seal on cup", and "lips close around straw" were combined into "lips touch solid or utensil" as "seal" and "close" suggest a level of strength. Although all oral-motor and feeding skills within the function "awareness" were written specifically for the spoon (i.e., brings head forward to spoon, turns head to spoon, leans towards spoon), skills were relevant to any texture or utensil (i.e., brings head forward to cracker, brings head forward to cup).

Multiple movements described within one oral-motor skill were separated or re-written into an individual oral-motor skill. For example, "lateral movements of tongue" actually describes two different possible skills such as "bolus moved into right cheek with tongue" and "bolus moved into left cheek with tongue" or "lips close on solid or utensil" describes two different possible skills such as "upper lip touches solid or utensil"; and "lower lip touches solid or utensil". The term "solid or utensil" was used to indicate any solid or utensil that could be presented to an individual. The term "utensil" was used to indicate spoon, cup or straw. The

term “bolus” was used to indicate any food or liquid accepted into the mouth, manipulated or swallowed.

After all 67 scorable oral-motor skills were reviewed and edited, 50 skills remained. See Appendix F for processes used to review and edit each of the 67 scorable oral-motor skills and the remaining 50 skills. Five of the original feeding experts, who worked specifically with feeding and swallowing patients, were then asked to evaluate the refined set of 50 oral-motor skills. Specifically, judges were asked to review each skill and answer the question: “Is this oral-motor skill important to observe during a feeding observation?” They were also asked to identify any oral-motor skills they felt were important to observe that were not included on the list. It was predetermined that skills would be deleted, re-written, or added if 4 of 5 experts agreed.

All of the 50 skills (100%) were rated as important to observe by at least 80% of the judges (4 of 5). Results indicated that 2 of 5 experts felt that “fixes gaze on solid or utensil” and 1 of 5 experts felt that “reaches for solid or utensil”, “jaw moves vertically in midline”, “spoon is cleared”, and “lower lip draws inward after removal of solid or utensil” were not important to observe but did not meet criteria to delete. In addition, 4 of 5 experts felt that the oral-motor skill “fixes gaze on solid or utensil” be re-written to say “looks at solid or utensil”. Eight additional oral-motor skills not included on this list were identified as important to observe by 4 of 5 experts and were added to the list: up/down tongue movement for bolus manipulation; forward/backward tongue movement for bolus manipulation; holds head steady in midline during bolus manipulation; holds head steady in midline during swallowing; bites in front of mouth; bolus outside of mouth is cleared; fingers used to move bolus in mouth; opens mouth when solid or utensil touch lips. Oral-motor skills were rewritten to reflect the expected outcome.

Unique organization of 52 core oral-motor skills. Following expert review, 58 oral-motor skills were identified as important to observe during a clinical feeding observation. Only two skills (i.e., consecutive swallow, single-sip-swallow) were specific only to liquids and were removed from the final list, as for the purposes of this project, liquids would not be studied. The 56 oral-motor skills for purees and solids were then placed in order to reflect the sequence of physiologic events expected during the phase of the feeding process (i.e., acceptance, manipulation, transfer and swallow). Once skills were organized in this manner, four redundant oral-motor skills were identified (i.e., the skills reflected conceptually similar information just worded in a negative form). For example, "no bolus loss from mouth during acceptance" and "bolus loss from mouth during acceptance" was unnecessary and thus the latter was omitted. To maintain the original list of skills identified by experts, all 56 skills are listed in Appendix G, but four skills were eliminated from analyses (i.e., oral skill 23, 43, 48, and 50). The final list of scorable oral-motor skills is organized according to phase of the feeding process and texture, an approach that is unique to this measure and represents oral-motor skills that are deemed important to observe as validated by experts. Appendix G shows the final list of oral-motor skills and the 12 remaining corresponding functions. The final measure focuses on the normal aspects of oral-motor and feeding development that can be clinically observed without instrumental measurement. A key facet of the next phase of this study was to determine whether developmental differences among transitional feeders could be detected on the basis of these skills alone.

The following research questions were addressed:

1. Does clinical assessment of the targeted oral-motor skills reveal differences among children 8, 10, and 12 months of age?
    a. Are there differences within textures and across all oral-motor skills for age groups?
    b. Are there differences across textures and within oral-motor skills for age groups?
    c. Are there differences within textures and within oral-motor skills for age groups?

2. What patterns of emergence and mastery are revealed by clinical assessment of the targeted oral-motor skills for children 8, 10, and 12 months of age?
    a. What is the pattern of emergence and mastery within textures and across all oral-motor skills for age groups at each quartile performance level?
    b. What is the pattern of emergence and mastery within textures and within oral-motor skills for age groups at each quartile performance level?

3. Does clinical assessment of the targeted oral-motor skills reveal differences among children 8, 10, and 12 months of age with different experience levels?
    a. Are there differences within textures and across all oral-motor skills for experience groups?
    b. Are there differences across textures and within oral-motor skills for experience groups?

   c. Are there differences within textures and within oral-motor skills for experience groups?

4. What patterns of emergence and mastery are revealed by clinical assessment of the targeted oral-motor skills for children 8, 10, and 12 months of age with different experience levels?
   a. What is the pattern of emergence and mastery within textures and across all oral-motor skills for experience groups at each quartile performance level?
   b. What is the pattern of emergence and mastery within textures and within oral-motor skills for experience groups at each quartile performance level?

Phase II

Phase II of this project addressed measurement of oral-motor skill development in typically developing children using the 52 oral-motor skills identified from and described in the pilot study (Phase I).

Participants. This investigation employed a cross-sectional methodology to examine typically developing children at ages of 8, 10, and 12 months. Data were collected from three target age groups (i.e., 8, 10, and 12 months). The age groups were selected because from 6-12 months of age, children are expected to transition from sustaining all nutrition and hydration solely from bottle or breast feeding to eating a variety of solids and drinking from a cup by their first birthday. Children who are 8, 10, and 12 months of age would be expected to be well into this transition. To reduce performance variability associated with chronologic age, children of specific ages (i.e., 8 months + or – 2 weeks) were studied for this project instead of consecutive age-ranges (i.e., 8-10 months, 10-12 months). Based on a power analysis, 21 children were recruited for each age group, for a total of 63 children. See Table 9 for a description of participant information by age group.

Table 9: Demographic information of 63 participants by age group

Age group	Gender		Age Range (weeks)	Mean Age weeks (±sd)
	Male	Female		
8	11	10	30-33	31.8 (±1.37)
10	11	10	38-42	39.8 (±1.37)
12	7	14	46-49	47.6 (±1.12)

Each age group contained 21 participants and was balanced for gender with the exception of the 12-month group, which contained 7 males and 14 females. All racial / ethnic groups were accepted. Participants were recruited through community-wide flyers placed at daycare centers,

pediatrician's offices, and child-friendly locations, such as Mommy and Me and Gymboree classes throughout southern Wisconsin.

Participants were typically developing, with no known disabilities, and no history of developmental therapies or current enrollment in developmental therapies. Inclusion criteria were as follows: 1.) full-term gestation (greater than or equal to 37 weeks), 2.) birth weight of at least 5 ½ pounds, 3.) absence of neonatal and birth anomalies (e.g., seizures, oral-facial structural anomalies, gastrointestinal anomalies), 4.) current weight greater than or equal to the 5th percentile for age, 5.) minimum of two weeks experience with spoon feeding prior to the data collection session. Current weight and height of each child was taken by parent report. If height was unknown, a flexible measuring tape was used to determine each child's length.

Pre-session procedures. The experimenter was contacted via phone or email by parents or caregivers who were interested in enrolling their child in this study. A phone interview lasting no longer than 30 minutes or email communication was conducted with the child's parent or caregiver. A series of questions were asked about the child's history and current status to ensure that the child met the inclusion criteria. If the child did not meet the inclusion criteria and this raised concern, the parent was encouraged to return to the primary care physician to discuss concerns. Contact information for local service providers was provided as requested.

To ensure typical development, the parent or caregiver was mailed or emailed the Communication and Symbolic Behavior Scales Developmental Profile Infant-Toddler Checklist (CSBS DP Infant-Toddler Checklist) (used for children 6 to 24 months) prior to scheduling an appointment. If the child passed the CSBS screener, an appointment was scheduled and the parent or caregiver received a packet in the mail one week prior to the data collection session. A description of the feeding instructions, the consent form, and a feeding questionnaire created by

the investigator (feeding history, feeding status etc.) accompanied the packet mailed to the parent or caregiver. See Developmental Questionnaire in Appendix H.

Data Collection Session Procedures. At the beginning of the data collection session, the parent or caregiver had an opportunity to ask any questions about the forms. The questionnaire and the consent form were collected after consent was obtained and before data collection began. The research took place in the child's home, daycare setting or another specified location, depending on the parent or caregiver's preference. The child's participation required up to one hour of time during one session. However, a second session was utilized on one occasion due to an illness. The child participant was videotaped during the feeding using a Canon ZR 100 digital video camcorder. The camera was positioned on a tripod behind and over the shoulder opposite of the feeding hand of the experimenter or parent / caregiver to ensure an unobstructed view of the child's mouth. The camera frame included primarily the child's face during the feeding. The child was seated in his / her usual feeding position while eating foods within his / her current diet (to ensure feeding and swallowing safety).

The data collection session consisted of a structured feeding with standard textures, utensils and presentation procedures. The examiner or parent / caregiver fed the child a small portion of his / her meal consisting of three presentations of different food textures. Five different textures of foods were used for the study (i.e., smooth puree, textured puree, diced solids, cracker piece, cracker whole). The parent or caregiver was instructed to have one item available from each texture category within their child's diet as detailed in Table 10. The listed foods were simply examples of the texture and the parent or caregiver was free to choose what was in the child's current diet. The examiner provided certain foods upon request of the parent or caregiver.

Table 10: Texture categories studied and examples of foods by texture for the structured feeding

Smooth puree	Textured puree	Diced solid	Dissolvable solid	
			Cracker piece	Whole cracker
Stage 1	Stage 3 dinner	Fruits	Gerber puffs	Ritz cracker
Stage 2	Cottage cheese	Vegetable	Dry cereal	Saltine cracker
Yogurt	Yogurt with chunks	Soft meat	Pieces from	
Pudding	Mashed table food		whole cracker	

The examiner brought a spoon to be used for the structured feeding. The same type of spoon was used for all participants to ensure that similar bolus sizes were provided to each child. The First Years ® Take & Toss infant spoons were used. These spoons are intended for use with children aged 4 months and older.

The parent or caregiver completed all structured feedings unless unavailable (e.g., daycare meal). The parent or caregiver was instructed of the feeding guidelines as outlined below to guarantee standard presentation of the food with standard utensils. The examiner or parent / caregiver offered three individual presentations of each texture in any order they chose. The following standard procedures were followed for each feeding session as adapted from Reilly and colleagues (2000) and Stolovitz and Gisel (1991):

1. Smooth puree, textured puree and diced solids should be offered to the child from the spoon in the horizontal plane perpendicular to the child's mouth and must be held to the child's lips to observe the child's attempts to remove the food from the spoon. If the child opens his / her lips but does not lean forward, the spoon should be inserted into the child's mouth but should be removed in the same horizontal plane and not angled upwards to scrape the bolus onto the gums or teeth. If the child does not accept the presentation, the spoon should be withdrawn and re-presented to the child's mouth. A total of three presentations are allowed before the trial is considered refused.

2. After acceptance of the food, a new presentation should be offered when the mouth has been determined clear of the previous presentation. If mouth clearing is unable to be determined, visual confirmation can be made when the child opens his/her mouth for the next presentation.
3. The examiner or parent / caregiver should not scrape the child's chin or lips if food remains in order to observe the child's attempts to clear any residual material from his / her lips.
4. Two types of crackers should be offered. The cracker choices are items that a) require the child to bite off a piece from the whole cracker, and b) a cracker piece that the child can place into his / her mouth. The cracker should be placed on the tray or handed to the child. If the child does not or is unable to hold or pick up the cracker, the cracker should be presented in the same manner as the spoon. The cracker must not be broken off against the child's teeth. The child can make as many attempts as needed to break off a piece of the cracker.

The structured feeding lasted no more than 30 minutes in total. No specific in vivo data were taken. Table 11 shows the number of participants by age and textures taken.

Table 11: Number (percent) of participants given specific textures by age group

Texture	8 months	10 months	12 months
Smooth puree (SP)	21 (100%)	21 (100%)	21 (100%)
Textured puree (TP)	16 (76%)	21 (100%)	20 (95%)
Solid (S)	14 (67%)	17 (81%)	18 (86%)
Cracker piece (CP)	13 (62%)	19 (90%)	21 (100%)
Cracker whole (CW)	10 (48%)	20 (95%)	21 (100%)

Scoring and Analysis. Following the data collection session, the DV tape of the structured feeding was transferred from the digital camcorder to an iMac G5 desktop computer into the Quicktime Pro software program. The Quicktime Pro software allowed for parsing video and grouping video clips. All three trials of each food texture given to the child were parsed from the structured feeding and were scored for the presence or absence of the oral-motor skills identified in Phase I of this project. Scoring was completed via the dichotomous paradigm, "yes" or "no". A "yes" score indicated observation of the oral-motor skill. "Yes" scores were coded as "1" and "no" scores were coded as "0". A varying number of oral-motor skills were scored for each texture because not all skills were expected for every texture (these skills are "grayed" out on the data collection form). For example, for smooth puree there were 43 oral-motor skills scored for each trial. For textured puree, there were 45 oral-motor skills scored for each trial. For diced solids, there were 45 oral-motor skills scored for each trial. For cracker piece, there were 41 oral-motor skills scored for each trial. For cracker whole, there were 49 oral-motor skills scored for each trial. Collectively, there were a total of 223 possible scores for each child if each texture was accepted and all skills were scorable. The Trial 2 rating for each skill was subjected to analysis. If Trial 2 was scored as "0" or not performed, Trial 3 and then Trial 1 were examined. If either Trial 3 or Trial 1 were scored as "1" or performed, the skill was counted as "performed" for the analyses. If all trials were scored as "0", the skill was counted as "not performed". This procedure minimized missing data due to unaccepted and unscorable trials. As Table 11 indicated above, many children did not take all textures due to their young age and so across children, skills, and textures (63 x 52 x 5), there were a total of 11,043 scorable observations used for analyses.

The investigator scored all conditions according to the operational definitions and scoring rules found in Appendix I. The investigator re-scored all trials from approximately 20% of the children to determine intra-rater reliability. A second experienced SLP independently scored all trials from approximately 20% of the children (9 children total) to determine inter-rater reliability. This rater received approximately four hours of training using video clip examples of scoring criteria for each oral-motor skill. Raters were allowed to watch each trial multiple times as there were multiple oral-motor skills to be scored per trial. Raters were also allowed to use real-time or slow motion viewing for scoring. Percentage agreement values were calculated as (agreements) / (agreements + disagreements) multiplied by 100. Intra-rater agreement was 91%. Inter-rater agreement was 78%. Appendix J and K shows agreement values for each texture and across all textures.

CHAPTER III: RESULTS

Differences in oral-motor skill performance by age

Differences within textures and across all oral-motor skills for age groups. Based on the literature review, performance differences by texture were expected. To examine the relationship of age on texture, data were collapsed across all skills within each of the five textures for each age group. In particular, it was hypothesized that mean performance on the earlier introduced textures would be higher than on more advanced textures by age. Means reflecting percentage of performance by texture for the three age groups are shown in Table 12.

Table 12: Average number (percent) of children within each age group performing an oral-motor skill within each texture. Numerator reflects the average number of children within each age group performing a given skill (collapsed across skills) within texture. Denominator reflects the average number of scorable observations (collapsed across skills) within each age group and texture.

Texture	8 months Number (%)	10 months Number (%)	12 months Number (%)
SP	14.6/20.4 (71.6%)	14.9/20.6 (72.3%)	14.9/20.4 (73%)
TP	10.7/15 (71.3%)	14.8/20.3 (72.9%)	13.9/18.8 (73.9%)
S	9.7/12.4 (78.2%)	12.6/15.8 (79.7%)	12.2/15.9 (76.7%)
CP	8.9/11.3 (78.8%)	13.6/16.6 (81.9%)	14.4/18.2 (79.1%)
CW	6.7/8.8 (76.1%)	13.5/17.4 (77.6%)	14.2/17.7 (80.2%)

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Descriptive findings indicated that mean performance was lower for the earlier introduced textures and higher for more advanced textures. This finding was consistent within each of the three age groups.

Differences across textures and within oral-motor skills for age groups. Data were collapsed across textures to examine differences in performance for each skill by age. Descriptive findings indicated that there were considerable differences in performance for individual skills. Raw data are provided in Appendix L.

Independent t-tests were conducted to compare differences between the three age groups for each skill (collapsed across texture). Sixteen contrasts were significant at an alpha level of .05 or less for 11 of the 52 different oral-motor skills.

For children in the 8 vs. 10-month age groups, contrasts were significant for five different skills (Skills 1, 4, 51, 52, and 56). Of these, mean performance for all five skills was higher for children in the 10-month group.

For children in the 10 vs. 12-month age groups, contrasts were significant for two different oral-motor skills (Skills 4 and 52); in both cases, mean performance was higher for children in the 10-month group.

For children in the 8 vs. 12-month age groups, contrasts were significant for 9 different oral-motor skills. Of these, the 12-month group had higher mean performance than the 8-month group on six skills (Skills 1, 5, 30, 45, 51, and 56), and the 8-month group had higher mean performance on three skills (Skills 12, 20, and 41). Table 13 provides a summary of oral-motor skills that were significant by age group. Inferential statistics for all contrasts are provided in Appendix M.

Table 13: Significant contrasts reflecting proportion of children by age group performing targeted oral-motor skill (OMS) and corresponding function across all textures.

OMS	Function	8 vs. 10	10 vs. 12	8 vs. 12
1	2	.45<.69		.45<.70
4	2	.27<.54	.54>.39*	
5	2			.34<.51
12	16			.97>.89*
20	11			.70>.55*
30	3			.30<.76
41	13			.99>.91*
45	2			.92<.99
51	14	.18<.39		.18<.38
52	14	.71<.92	.92>.77*	
56	14	.25<.43		.25<.43

*Contrasts opposing predicted direction

OMS number and description:
1. Brings head forward to solid or utensil; 4. Leans towards solid or utensil; 5. Reaches towards solid or utensil; 12. Tongue remains in mouth while solid or utensil enters; 20. Lower lip draws inward after removal of solid or utensil; 30. Bites completely through solid in one motion; 41. No bolus loss during bolus manipulation; 45. Holds head steady slightly forward in midline during swallowing; 51. Hand used to wipe bolus outside of mouth; 52. Lips used to retrieve food left outside of mouth; 56. Bolus outside of mouth cleared

Function number and description:
2. Awareness; 3. Biting; 11. Lip closure-object; 13. Maintenance; 14. Retrieval; 16. Tongue position

Differences within textures and within oral-motor skills for age groups. When data were examined within textures and skills for each of the three age groups, descriptive findings indicated that there were considerable differences in performance for individual skills by texture. Raw data are found in Appendices N, O, and P. Table 14 shows findings.

Independent t-tests were conducted to compare differences among the three age groups for each oral-motor skill within each of the five textures. Eighteen contrasts were significant at an alpha level of 0.05 or less for 11 different skills.

Within smooth puree, there was one significant contrast and it was for 8 vs. 10-month groups (Skill 1); mean performance was higher for the 10-month group than for the 8-month group on this skill.

Within textured puree, there were six significant contrasts, associated with four different skills. Two contrasts were significant for the 8 vs. 10-month groups (Skills 38 and 52); in both cases, mean performance was higher for the 8-month group than for the 10-month group. Two contrasts were significant for the 10 vs. 12-month groups (Skills 4 and 52); in both cases, mean performance was higher for the 10-month group than the 12-month group. Finally, two contrasts were significant for the 8 vs. 12-month groups (Skills 38 and 45); in both cases, mean performance was higher for the 12-month group than for the 8-month group.

Within solid, there were three significant contrasts, associated with three different skills. One contrast was significant for the 8 vs. 10-month group (Skill 52); mean performance was higher for the 10-month group than for the 8-month group. One contrast was significant for the 10 vs. 12-month group (Skill 17); mean performance was higher for the 10-month group than for the 12-month group. Finally, one contrast was significant for the 8 vs. 12-month group (Skill 45); mean performance was higher for the 12-month group than the 8-month group.

Within cracker piece, there were two significant contrasts; both were associated with Skill 5. One contrast was significant for the 8 vs. 10-month group and one contrast was significant for the 8 vs. 12-month group. In both cases, mean performance was higher for the 10 and 12-months groups than the 8-month group.

Within cracker whole, there were six significant contrasts, associated with five different skills. One contrast was significant for the 8 vs. 10-month group (Skill 47); mean performance was higher for the 10-month group than the 8-month group. One contrast was significant for the 10 vs. 12-month group; mean performance was higher for the 12-month group than the 10-month group. Finally, four contrasts were significant for the 8 vs. 12-month group (Skill 1, 30, 42, and 49); in all cases, mean performance was higher for the 12-month group than the 8-month group.

Table 14 provides a summary of oral-motor skills that were significant for age and texture. Inferential statistics for all contrasts are provided in Appendices Q, R, S, T, and U.

Table 14: Significant contrasts by age and texture for oral-motor skills (OMS) and corresponding function. Values in the table reflect age groups of the children.

OMS	Function	SP	TP	S	CP	CW
1	2	8<10				8<12
4	2		10>12*			
5	2				8<10; 8<12	
17	11			10>12*		
30	3					8<12
38	2		8<10; 8<12			
42	16					8<12
45	2		8<12	8<12		
47	13					8<10
49	16					8<12; 10<12
52	14		8<10; 10>12*	8<10		

*Contrasts opposing predicted direction; Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

OMS number and description:
1. Brings head forward to solid or utensil; 4. Leans towards solid or utensil; 5. Reaches towards solid or utensil; 17. Bolus removed from spoon with both lips; 30. Bites completely through solid in one motion; 38. Holds head steady slightly forward in midline during bolus manipulation; 42. Tongue remains in mouth during bolus manipulation; 45. Holds head steady slightly forward in midline during swallowing; 47. No bolus loss while pushing it backwards to swallow; 49. Tongue remains in mouth as bolus is pushed backwards to swallow; 52. Lips used to retrieve food left outside of mouth

Function number and description:
2. Awareness; 3. Biting; 11. Lip closure-object; 13. Maintenance; 14. Retrieval; 16. Tongue position

Emergence and mastery of oral-motor skills by age

Emergence and mastery within textures and across all oral-motor skills for age groups at each quartile performance level. In order to examine data within textures and skills for each of the three age groups, data were organized by performance levels. Note that performance levels were defined by statistical quartiles; that is, skills were separated by those that 0 - 24%, 25 - 49%, 50 - 74%, and 75 - 100% of children within an age group performed for each texture. Emergence was defined as skills that 50 -74% of children performed and mastery was defined as

skills that 75% or more of children performed. Summaries of these descriptive data are shown for each age group in Tables 15, 16, and 17.

Table 15: Number (percent) of oral-motor skills performed by 0 - 24%, 25 - 49%, 50 - 74%, and 75 - 100% of children within the 8-month age group for each texture

	Performance level				
Texture	0-24%	25-49%	50-74%	75%>	Total
SP	6 (13.1%)	6 (13.1%)	3 (7.1%)	28 (65.1%)	43
TP	7 (15.6%)	6 (13.3%)	5 (11.1%)	27 (60%)	45
S	8 (17.8%)	1 (2.2%)	4 (8.9%)	32 (71.1%)	45
CP	5 (12.2%)	1 (2.4%)	8 (19.5%)	27 (65.9%)	41
CW	5 (10.2%)	7 (14.3%)	2 (4.1%)	35 (71.4%)	49
Total	31 (13.9)	21 (9.4%)	22 (9.9%)	149 (66.8%)	223

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Table 16: Number (percent) of oral-motor skills performed by 0 - 24%, 25 - 49%, 50 - 74%, and 75 -100% of children within the 10-month age group for each texture

	Performance level				
Texture	0-24%	25-49%	50-74%	75%>	Total
SP	6 (14.3%)	7 (16.7%)	3 (7.1%)	26 (61.9%)	42
TP	4 (9%)	9 (20.5%)	5 (11.4%)	26 (59.1%)	44
S	7 (15.6%)	1 (2.2%)	7 (15.6%)	30 (66.7%)	45
CP	5 (12.2%)	0 (0%)	4 (9.8%)	32 (78%)	41
CW	7 (14.3%)	2 (4.1%)	4 (8.2%)	36 (73.5%)	49
Total	29 (13.1%)	19 (8.6%)	23 (10.4%)	150 (67.9%)	221

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Table 17: Number (percent) of oral-motor skills performed by 0 - 24%, 25 - 49%, 50 - 74%, and 75 - 100% of children within the 12-month age group for each texture

	Performance level				
Texture	0-24%	25-49%	50-74%	75%>	Total
SP	5 (11.9%)	6 (14.3%)	5 (11.9%)	26 (61.9%)	42
TP	5 (11.1%)	6 (13.3%)	4 (8.9%)	30 (66.7%)	45
S	4 (8.9%)	6 (13.3%)	7 (15.6%)	28 (62.2%)	45
CP	5 (12.2%)	1 (2.4%)	7 (17.1%)	28 (68.3%)	41
CW	7 (14.3%)	0 (0%)	7 (14.3%)	35 (71.4%)	49
Total	26 (11.7%)	19 (8.6%)	30 (13.5%)	147 (66.2%)	222

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Descriptive findings indicated that a similar number of skills were emerging and mastered for children in each age group. However, it was unknown if these emerging and mastered skills were common across age or texture.

Emergence and mastery within textures and within oral-motor skills for age groups at each quartile performance level. Individual skills were examined to determine commonalities across age and texture for emergence and mastery as shown in Table 18 and Table 19. Raw data are provided in Appendices V, W, and X.

Table 18: Number of emerging and mastered oral-motor skills common within and across the three age groups across all textures

Age group	Emerging	Mastered
8 months	0	27
10 months	1	28
12 months	0	25
Common skills	0	24

Table 19: Number of emerging and mastered oral-motor skills common within and across the five textures across all age groups

Texture	Emerging	Mastered
SP	1	26
TP	1	25
S	1	26
CP	3	33
CW	0	26
Common skills	0	24

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Descriptive findings within age indicated that there were no common emerging skills. However, there were 24 common skills mastered across age groups.

Descriptive findings within texture also indicated that there were no common emerging skills. However, there were 24 common skills mastered across textures. The 24 common skills

mastered by age and textures were the same. Thus, children mastered 24 (46.2%) oral-motor skills regardless of age or texture.

Children regrouped by experience

Standardization of experience of all children for each texture. In order to examine the effect of experience on oral-motor skill development, children were regrouped based on the amount of experience reported by parents for each texture. Table 20 reflects the range and average age at texture introduction as indicated by parent report.

Table 20: Range and average age at texture introduction as indicated by parent report

	Introduction Range (weeks)			Introduction Mean age (weeks)		
Texture	8 months	10 months	12 months	8 mo	10 mo	12 mo
Smooth puree	12 to 24	8 to 24	12 to 24	18.2	18	18.4
Textured puree	22 to 34	24 to 38	22 to 40	28.3	29.8	31.6
Solid	24 to 32	24 to 40	20 to 48	29.9	34.6	38.7
Cracker piece	24 to 32	24 to 40	20 to 44	27.8	31.2	32.9
Cracker whole	24 to 32	24 to 40	20 to 44	27.8	31.2	32.9

Descriptive findings indicated that there was considerable variability in age of introduction for each texture. Mean age at introduction of smooth puree was generally consistent across the three age groups. However, children in the 8-month group tended to be introduced to other textures earlier than children in the 10 and 12-month groups. Conversely, children in the 12-month group tended to be introduced to other textures later than children in the 8 and 10-month groups. Overall, children were introduced to the solid texture last. Using parent-reported age of introduction for each texture, the range and average amount of experience were then calculated based on each child's age in weeks on the day of data collection and age at the time of texture introduction. Table 21 reflects the range and average amount of experience.

Table 21: Range and average number of weeks of texture experience determined by subtracting chronological age (weeks) at time of data collection minus age of texture introduction (weeks) as indicated by parent report

	Experience Range (weeks)			Experience Mean age (weeks)		
Texture	8 months	10 months	12 months	8 mo	10 mo	12 mo
Smooth puree	7 to 21	14 to 33	22 to 37	13.6	21.8	29.2
Textured puree	0 to 9	0 to 17	0 to 27	2.5	9.4	15.2
Solid	0 to 6	0 to 15	0 to 29	1.2	5.3	8.9
Cracker piece	0 to 9	0 to15	4 to 26	3.8	8.6	14.7
Cracker whole	0 to 9	0 to15	4 to 26	3.8	8.6	14.7

Descriptive findings indicated that average weeks of experience increased as age increased, as expected. Findings also indicated that there was considerable variability in the amount of experience among children.

In order to standardize and sort children into groups based upon experience, the means and standard deviations for weeks of experience across all children were converted to z-scores. Conversions were completed for each texture as children were introduced to textures at different times, thus experiences groups were comprised of different children for each texture. However, within textures, experience group members were mutually exclusive. Children were sorted by their corresponding z-scores for each texture. Children with the least amount of experience had z-scores for texture less than or equal to -1SD from the mean (i.e., least experienced). Children with an average amount of experience had z-scores between -0.9 and +0.9 SD (i.e., average experienced). Children with the most amount of experience had z-scores greater than or equal to +1SD (i.e., most experienced) from the mean. See Table 22 for distribution. From this point forward, the three experience groups will be referred to as least, average, and most experienced for each texture.

Table 22: Number of children within each age group falling into the corresponding experience group for each texture (i.e., SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole).

Texture	Experience group			
SP	Least	Average	Most	Number of children reporting
8 months	11	10	0	21
10 months	0	18	1	19
12 months	0	7	13	20
TP	Least	Average	Most	Number of children reporting
8 months	9	6	0	15
10 months	2	14	2	18
12 months	1	9	8	18
S	Least	Average	Most	Number of children reporting
8 months	11	3	0	14
10 months	5	10	1	16
12 months	0	14	3	17
CP	Least	Average	Most	Number of children reporting
8 months	7	5	0	13
10 months	4	14	0	18
12 months	0	14	6	20
CW	Least	Average	Most	Number of children reporting
8 months	5	4	0	9
10 months	3	15	0	18
12 months	0	14	6	20

Distribution was as expected for the earliest introduced texture, smooth puree, with only 8-month old children in the least experienced group. However, nearly one-half (10 of 21) of the 8-month old children fell into the average experience group for smooth puree. The 12-month old children primarily comprised the group with the most experience for smooth puree. For all other textures, the 12-month group had less than expected experience with the majority of the children in the average experience group. Overall, the assignment of children into experience groups resulted in distinctly different groupings than did chronological age.

Differences in oral-motor skill performance by experience

Differences within textures and across all oral-motor skills for experience groups. Based on the literature review, performance differences by texture were expected. To examine the effect of texture, data were collapsed across all skills within each of the five textures for each experience group. In particular, it was hypothesized that performance on earlier introduced textures would be higher than on advanced textures for the experience groups. Means reflecting percentage of performance by texture by the experience groups are shown in Table 23.

Table 23: Average number (percent) of children within each experience group performing an oral-motor skill within each texture. Numerator reflects the average number of children within each experience group performing a skill (collapsed across skills) within texture. Denominator reflects the average number of scorable observations (collapsed across skills) within each experience group and texture.

Texture	Least Experience Number (%)	Average Experience Number (%)	Most Experience Number (%)
SP	7.8/10.7 (73.1%)	24.6/34.4 (71.5%)	10.2/13.6 (75%)
TP	8.2/11.3 (72.4%)	20.2/27.2 (74.3%)	6.9/9.7 (71.1%)
S	11.1/14.1 (78.3%)	18.5/23.9 (77.4%)	3.3/3.8 (86.8%)
CP	7.7/9.7 (79.4%)	23.4/28.8 (81.3%)	3.9/5.1 (76.5%)
CW	5.1/6.8 (76.1%)	22.7/28.7 (79.1%)	3.8/4.8 (79.2%)

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Consistent with findings for chronological age data, descriptive findings indicated that mean performance was lower on the earlier introduced textures and higher for more advanced textures. This finding was consistent within each of the three experience groups.

Differences across textures and within oral-motor skills for experience groups. Data were collapsed across textures to examine differences in performance for each individual skill by experience. Descriptive findings indicated that there were considerable differences in performance for individual skills. Table 24 provides a summary of oral-motor skills that were significant by experience group. Raw data are provided in Appendix Y.

Independent t-tests were conducted to compare differences between the three experience groups for each skill (collapsed across texture). Seven contrasts were significant at an alpha level of .05 or less for five different oral-motor skills.

For children in the least vs. the average experienced groups, contrasts were significant for four different skills. Of these, the average experienced group had higher mean performance than the least experienced group for three skills (Skills 7, 9, and 45), and the least experienced group had a higher mean performance on one skill (Skill 12).

For children in the average vs. the most experienced groups, contrasts were significant for one skill (Skill 7); mean performance was higher for the average experienced group than the most experienced group.

For children in the least experienced vs. most experienced group, contrasts were significant for two different skills (Skills 12 and 20); in both cases, mean performance was higher for the least experienced group than the most experienced group. Inferential statistics for all contrasts are provided in Appendix Z.

Table 24: Significant contrasts reflecting proportion of children by experience group performing targeted oral-motor skill (OMS) and corresponding function across all textures

		Experience groups		
OMS	Function	Least vs. Average	Average vs. Most	Least vs. Most
7	9	.95<1.0	1.0>.98*	
9	9	.90<.99		
12	16	1.0>.91*		1.0>.92*
20	11			.71>.50*
45	2	.89<.97		

*Contrasts opposing predicted direction

OMS number and description:
7. Opens mouth when solid or utensil is brought to mouth; 9. Opens mouth before solid or utensil touches lips; 12. Tongue remains in mouth while solid or utensil enters; 20. Lower lips draws inward after removal of solid or utensil; 45. Holds head steady slightly forward in midline during swallowing;

Function number and description:

2. Awareness; 9. Jaw opening; 11. Lip closure-object; 16. Tongue position

Differences within textures and within oral-motor skills for experience groups. When data were examined within textures and skills for each of the three experience groups, descriptive findings indicated that there were considerable differences in performance for each skill by texture. Table 25 provides a summary of oral-motor skills that were significant for experience and texture. Raw data are provided in Appendices AA, BB, and CC.

Independent t-tests were conducted to compare differences among the three experience groups for each skill within each of the five textures. Twenty-two contrasts were significant at an alpha level of .05 or less for 16 different skills.

Within smooth puree, there were three significant contrasts, associated with three different oral-motor skills. One contrast was significant for the least experienced vs. average experienced groups (Skill 5); mean performance was higher for the least experienced group than the average experienced group. Two contrasts were significant for the average experienced vs. most experienced groups (Skills 19 and 51); in both cases, performance was higher for the most experienced group than the average experienced group.

Within textured puree, there were five significant contrasts, associated with three different skills. Two contrasts were significant for the average experienced vs. most experienced groups; mean performance was higher for the most experienced group than the average experienced group for one skill (Skill 19) and the mean performance was higher for the average experienced group than the most experienced group for the second skill (Skill 39). Finally, three contrasts were significant for the least experienced vs. most experienced groups; mean performance was higher for the most experienced group than the least experienced group for one skill (Skill 19) and mean performance was higher for the least experienced group than the most experienced group for two skills (Skills 35 and 39).

Within solid, there were two significant contrasts, associated with two different skills. One contrast was significant for the least experienced vs. the average experienced groups; mean performance was higher for the average experienced group than the least experienced group. Another contrast was significant for the average experienced vs. most experienced groups; mean performance was higher for the most experienced group than the average experienced group.

Within cracker piece, there were four significant contrasts, associated with four different skills (Skills 7, 14, 15, and 44). All contrasts were significant for the average experienced vs. most experienced groups; in all cases, mean performance was higher for the average experienced group than the most experienced group.

Within cracker whole, there were eight significant contrasts, associated with seven different skills. Six contrasts were significant for the least experienced vs. the average experienced groups (Skills 2, 5, 7, 28, 34, 45, and 47); in all cases, mean performance was higher for the average experienced group than the least experienced group. Two contrasts were significant for the average experienced vs. the most experienced groups; in both cases, mean performance was higher for the average experienced group than the most experienced group. Inferential statistics for all contrasts are provided in Appendices DD, EE, FF, GG, and HH.

Table 25: Significant contrasts by experience and texture for oral-motor skills (OMS) and corresponding function. Least denotes the least experienced group; Avg denotes the average experienced group; and Most denotes the most experienced group.

OMS	Function	SP	TP	S	CP	CW
2	2					Least<Avg
5	2	Least>Avg*				Least<Avg
7	9				Avg>Most*	Least<Avg
14	11				Avg>Most *	
15	11				Avg>Most *	
19	13	Avg<Most	Avg<Most; Least<Most			
28	3					Least<Avg
34	5					Avg>Most *
35	8		Least>Most*			
39	10		Avg>Most *; Least>Most*			
44	16				Avg>Most *	
45	2					Least<Avg
46	12			Avg<Most		
47	13					Least<Avg; Avg>Most *
51	14	Avg<Most				
55	14			Least<Avg		

*Contrasts opposing predicted direction; Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

OMS number and description:
2. Turns head to solid or utensil; 5. Reaches towards solid or utensil; 7. Opens mouth when solid or utensil is brought to mouth; 14. Lower lip touches bottom of solid or utensil; 15. Lips touch solid or utensil; 19. Food not observed outside of mouth; 28. Bites in front of mouth; 34. Chewing initiated after bolus enters mouth; 35. Up and down jaw movement when bolus is in mouth; 39. Lips closed during entire bolus manipulation; 44. No repetitive forward/backward tongue movement during bolus manipulation; 45. Holds head steady slightly forward in midline during swallowing; 46. Keeps lips closed during swallowing; 47. No bolus loss while pushing it backwards to swallow; 51. Hands used to wipe bolus outside of mouth; 55. Tongue used to retrieve bolus outside of mouth

Function number and description:
2. Awareness; 3. Biting; 5. Chewing; 8. Jaw movement; 9. Jaw opening; 10. Lip closure-manipulation; 11. Lip closure-object; 12. Lip closure-swallow; 13. Maintenance; 14. Retrieval; 16. Tongue position

Emergence and mastery of oral-motor skills by experience

Emergence and mastery within textures and across all oral-motor skills for experience groups at each quartile performance level. In order to examine data within textures and skills

for each of the three experience groups, data were organized by performance levels. Note that performance levels were defined by statistical quartiles; that is, skills were separated by those that 0 - 24%, 25 - 49%, 50 - 74%, and 75 - 100% of children within an experience group performed for each texture. Emergence was defined as skills that 50 - 74% of children performed and mastery was defined as skills that 75% or more of children performed. Summaries of these descriptive data are shown for each experience group in Tables 26, 27, and 28.

Table 26: Number (percent) of oral-motor skills performed by 0 - 24%, 25 - 49%, 50 - 74%, and 75 - 100% of children within the least experienced group for each texture

	Performance level				
Texture	0-24%	25-49%	50-74%	75%>	Total
SP	6 (14%)	4 (9.3%)	6 (14%)	27 (62.8%)	43
TP	7 (15.6%)	5 (11.1%)	3 (6.7%)	30 (66.7%)	45
S	7 (15.6%)	2 (4.4%)	5 (11.1%)	31 (68.9%)	45
CP	5 (12.2%)	0 (0%)	5 (12.2%)	31 (75.6%)	41
CW	5 (10.2%)	5 (10.2%)	7 (14.3%)	32 (65.3%)	49
Total	30 (13.5%)	16 (7.2%)	26 (11.7%)	151 (67.7%)	223

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Table 27: Number (percent) of oral-motor skills performed by 0 - 24%, 25 - 49%, 50 - 74%, and 75 - 100% of children within the average experienced group for each texture

	Performance level				
Texture	0-24%	25-49%	50-74%	75%>	Total
SP	4 (9.5%)	9 (21.4%)	3 (7.1%)	26 (61.9%)	42
TP	5 (11.1%)	7 (15.6%)	5 (11.1%)	28 (62.2%)	45
S	4 (8.9%)	4 (8.9%)	8 (17.8%)	29 (64.4%)	45
CP	5 (12.2%)	0 (0%)	4 (9.8%)	32 (78%)	41
CW	7 (14.3%)	1 (2%)	6 (12.2%)	35 (71.4%)	49
Total	25 (11.3%)	21 (9.5%)	26 (11.7%)	150 (67.6%)	222

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Table 28: Number (percent) of oral-motor skills performed by 0 - 24%, 25 - 49%, 50 - 74%, and 75 - 100% of children within the most experienced group for each texture

	Performance level				
Texture	0-24%	25-49%	50-74%	75%>	Total
SP	3 (7.1%)	6 (14.3%)	7 (16.7%)	26 (61.9%)	42
TP	9 (20.5%)	2 (4.5%)	8 (18.2%)	25 (56.8%)	44
S	1 (2.6%)	3 (7.7%)	2 (5.1%)	33 (84.6%)	39
CP	6 (14.6%)	3 (7.3%)	5 (12.2%)	27 (65.9%)	41
CW	0 (0%)	5 (11.4%)	4 (9.1%)	35 (79.5%)	44
Total	19 (9%)	19 (9%)	26 (12.4%)	146 (69.5%)	210

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Consistent with findings for chronological age data, descriptive findings indicated that a similar number of skills were emerging and mastered.

Emergence and mastery within textures and within oral-motor skills for age groups at each quartile performance level. To determine if these emerging and mastered skills were common across experience or texture, individual skills were examined, as shown in Tables 29 and 30. Raw data are provided in Appendices II, JJ, and KK.

Table 29: Number of emerging and mastered oral-motor skills common to the three experience groups across all textures

Experience group	Emerging	Mastered
Least	0	25
Average	1	30
Most	1	23
Common skills	0	21

Table 30: Number of emerging and mastered oral-motor skills common to the five textures across all experience groups

Texture	Emerging	Mastered
SP	0	25
TP	1	23
S	1	28
CP	1	26
CW	0	29
Common skills	0	21

Note: SP=smooth puree; TP=textured puree; S=diced solid; CP=cracker piece; and CW=cracker whole

Descriptive findings within experience indicated that there were no common emerging skills. However, there were 21 common skills mastered across experience groups.

Descriptive findings within texture also indicated that there were no common emerging skills. However, there were 21 common skills mastered across textures. The 21 common skills mastered by experience and textures were the same. Thus, children mastered 21 (40.4%) oral-motor skills regardless of experience or texture.

Common oral-motor skills mastered by children regardless of age, experience or texture.

Descriptive findings indicated that 24 skills were mastered regardless of age or texture and 21 skills were mastered regardless of experience or texture. Of these mastered skills, 21 of the skills were common regardless of age, experience, or texture. Table 31 shows the average number of times children performed the 21 core individual skills collapsed across textures.

Table 31: Average (percent) number of times (averaged across age and texture and experience and texture) an oral-motor skill was performed by 75% or more of the age group, experience group, function (Fnc) and for each texture. Note that the skills in bold reflect the three skills mastered for age but not for experience.

OMS	Fnc	All age groups and textures Number (%)	All experience groups and textures Number (%)	Oral-motor skill description
2	2	90 (98.5%)	83.7 (98.4%)	Turns head to solid or utensil
3	2	82.7 (90.5%)	77 (90.6%)	Looks at solid or utensil
6	2	88.7 (97.1%)	82.7 (97.3%)	Holds head steady during acceptance
7	9	90 (98.5%)	83.7 (98.4%)	Opens mouth when solid or utensil is brought to mouth
8	9	78 (99.2%)	73 (99.1%)	Jaw opens vertically in midline
9	9	87.3 (96%)	81.7 (96.5%)	Opens mouth before lips touched by solid or utensil
10	9	86.3 (95.2%)	80.3 (95.3%)	Mouth opens enough for solid or utensil to enter mouth
12	16	74.7 (93%)	70.7 (93.4%)	Tongue remains in mouth while solid or utensil enters
17	11	54 (95.3%)	50.3 (95.6%)	Bolus removed from spoon with both lips
18	11	73.7 (100%)	68.3 (100%)	Solid or utensil is removed from mouth without resistance
22	13	91 (100%)	84.7 (100%)	No bolus loss from mouth during acceptance
24	11	10.7 (78.1%)	**9.7 (78.4%)**	**Lips touch solid during biting**
25	3	17 (100%)	15.7 (100%)	Gums or teeth contact solid
28	3	16.7 (98%)	15.3 (97.9%)	Bites in front of mouth
29	3	15.7 (92.2%)	14.3 (91.5%)	Attempts to bite instead of only tasting or licking
33	15	86.3 (96.6%)	81 (97.6%)	No assistance from fingers to move bolus in mouth
35	8	6.7 (85.8%)	**71.7 (86.4%)**	**Up and down jaw movement when bolus is in mouth**
37	15	73.7 (94.9%)	67.7 (94.4%)	No repetitive up/down tongue movement during bolus manipulation
38	2	85 (95.2%)	78.7 (94.8%)	Holds head steady during bolus manipulation
40	10	83 (92.9%)	**76.7 (92.4%)**	**Lips closed intermittently during bolus manipulation**

Table 31 continued: Average (percent) number of times (averaged across age and texture and experience and texture) an oral-motor skill was performed by 75% or more of the age group, experience group and for each texture

OMS	Fnc	All age groups and textures Number (%)	All experience groups and textures Number (%)	Oral-motor skill description
41	13	85 (95.2%)	79.7 (96%)	No bolus loss during bolus manipulation
44	16	86.3 (97%)	80.7 (97.6%)	No repetitive forward/backward tongue movement during bolus manipulation
45	2	82 (95.4%)	76.3 (95.4%)	Holds head steady during swallowing
47	13	82.3 (95.7%)	77.3 (96.7%)	No bolus loss while pushing it backwards to swallow

CHAPTER IV: DISCUSSION

The focus of this study was to determine whether a set of clinically relevant oral-motor skills that were clinically observable would reveal differences among transitional feeders based on their age and on their experience with eating food of different textures. The study also examined emergence and mastery of the target oral-motor skills by age and experience groups. There were two components to the project. The first component involved an exhaustive review of the literature which revealed several major problems with current findings that included an inflated number of skills, inconsistent ages of skill mastery for individual skills, and overall lack of standardization. A second step involved identification of a comprehensive pool of oral-motor skills for typically developing children was identified from the existing literature. Validation procedures were then used to determine which skills were important and observable to experts. Skills that were identified by experts were categorized by function. Operational definitions for each skill within this core set of oral-motor skills were then developed based on the literature. Fifty-two different oral-motor skills were identified as being important and clinically observable for children in the transitional feeding period from this preliminary study.

In the second component of this study, three age groups of typically developing children (8, 10, and 12 months) in the transitional feeding period were examined for presence of the 52 oral-motor skills during feeding. Each of the 63 children (21 per group) was given three trials of five food textures that were in their current diet. Each of the 52 oral-motor skills was scored for the trials. A skill was scored as "1" if the child performed it at least one time, and "0" if the child did not perform it. Across children, skills, and textures (63 x 52 x 5), 11,043 observations were used in these analyses.

In another set of analyses, the same children were re-grouped based upon parent report of experience with each texture. Mastery and emergence of each of the 52 target oral-motor skills were also examined for children by both age and experience groups.

Results of this study showed there were differences among children of different age and experience groups on certain target oral-motor skills, both within and across textures. However, overall there were fewer differences than expected, and in fact, there were more similarities among children of different ages and experience levels for each of the textures and skills than there were differences. These findings refute conventional wisdom that children develop and acquire oral-motor skills in a systematic and step-wise process over the first year of life. With regard to emergence and mastery of the 52 target skills examined in this study, results suggest that children had mastered a common set of 21 oral-motor skills by 8 months of age. This was evident for each texture when children were grouped by age and when children were grouped by weeks of experience. Specific findings and the implications for the 52 target clinical oral-motor skills identified in Phase I of this study are discussed in detail, according to the 12 feeding functions that they represent, below.

Differences in oral-motor skill performance by age and experience

In this study, differences in skill performance were examined in two different ways: by chronological age and by experience level. For the first set of analyses, children were separated into three chronological age groups (i.e., 8, 10, and 12 months) based on their date of birth. For the second set of analyses, children were regrouped into three experience groups (i.e., least, average, and most experienced) for each texture based on parental report of the child's age at texture introduction. Although there was some overlap in group membership relative to age-

related groupings, a number of children were assigned to different groups than they had been in for the chronological age analyses. Ultimately, this resulted in groups that reflected different combinations of children than the age-based analyses. Based on the literature (Morris, 1982; Stolovitz & Gisel, 1991), it was hypothesized that there would be many significant differences in performance between age groups and experience groups for the various skills and textures. Findings for age and experience differences are discussed below.

Differences within textures and across all oral-motor skills for age and experience groups. When age and experience differences were examined within texture and across all skills, it was hypothesized that average performances on earlier introduced textures would be higher than for more advanced textures. However, descriptive findings revealed that for each of the three age and experience groups, the average performance was lower for smooth puree and textured puree than for more advanced textures. This means that children appeared to perform more similarly for each texture and performed "better" on more advanced textures, regardless of whether they were grouped according to age or experience.

Differences across textures and within oral-motor skills for age and experience groups. When data were examined for age and experience differences across textures and *within individual skills*, more differences were identified. One explanation is that when data were collapsed across textures, the finer grained differences among the age and experience groups were obscured. However, there were fewer significant performances than predicted.

Consistent with the hypothesis, comparisons between the 8 versus 12-month age groups yielded the greatest number of significant differences within individual skills. This finding suggests that there are important changes in oral-motor skill development between the ages of 8 and 12 months. However, it was somewhat surprising that there were not more significant

differences with regard to specific skills between these two age groups. Table 32 details the functions with significant skills for age and experience across all textures.

Among the nine skills with significant age contrasts between the 8 versus 12-month groups, six different functions were represented. These were awareness, biting, lip closure-object, maintenance, retrieval, and tongue position. Skills associated with the functions of awareness and retrieval made up more than half of the skills showing performances differences between 8 and 12-month groups. Specifically, fewer children in the 8-month group brought head forward to the solid (cracker whole), reached for the solid (cracker piece), held their head steady in midline during swallowing (textured puree and solid), used their hands to retrieve a bolus and cleared a bolus than the children in the 12-month group. For the biting function, fewer children in the 8-month group bit through a cracker in one motion than children in the 12-month group (cracker whole). For the lip closure-object, maintenance, and tongue position functions, more children in the 8-month group kept their tongue in the mouth during acceptance, drew in their lower lip after removal of the spoon, and maintained a bolus during manipulation (textured puree) than children in the 12-month group.

Consistent with the literature, general findings suggest that younger children perform certain skills differently than older children (Morris, 1982; Stolovitz & Gisel, 1991). One explanation for the so-called "better" performance of the younger children on some skills in the present study is that older children might have had more refined skills and have had greater movement capabilities so that they moved their tongue and other structures more during a meal resulting in changes in tongue position or bolus maintenance that was reflected as a lack of performance for certain skills. Previous studies also reported that as children aged, they tended

Table 32: The 12 functions with oral-motor skills with significant differences on t tests for age (CA) and experience (Exp) by texture and across all textures (number of contrasts in parentheses)

Group	Contrast	Smooth puree	Textured puree	Solid	Cracker piece	Cracker whole	Across all textures
CA	8 vs. 12 months	n/a	Awareness (2)	Awareness (1)	Awareness (1)	Awareness (1) Biting (1) Maintenance (1) Tongue position (1)	Awareness (3) Biting (1) Lip closure-object (1) Maintenance (1) Retrieval (2) Tongue position (1)
	8 vs. 10 months	Awareness (1)	Awareness (1) Retrieval (1)	Retrieval (1)	Awareness (1)	Maintenance (1)	Awareness (2) Retrieval (3)
	10 vs. 12 months	n/a	Awareness (1) Retrieval (1)	Lip closure-object (1)		Tongue position (1)	Awareness (1) Retrieval (1)
Exp	Least vs. Most	n/a	Jaw movement (1) Lip closure-manipulation (1) Maintenance (1)	n/a	n/a	n/a	Lip closure-object (1) Tongue position (1)
	Least vs. Average	Awareness (1)	n/a	Retrieval (1)	n/a	Awareness (3) Biting (1) Jaw opening (1) Maintenance (1)	Awareness (1) Jaw opening (2) Tongue position (1)
	Average vs. Most	Maintenance (1) Retrieval (1)	Lip closure-manipulation (1) Maintenance (1)	Lip closure-swallow (1)	Tongue position (1) Jaw opening (1) Lip closure-object (2)	Chewing (1) Maintenance (1)	Jaw opening (1)

to draw in their lower lip less often (Stolovitz & Gisel, 1991). Children may become more adept at maintaining the bolus with typical lip closure instead of drawing the lower lip inward.

The pattern of results was different when the effect of experience was examined across textures and within individual skills from what was observed for age group comparisons. Inconsistent with the hypothesis, and with findings for age groups, comparisons between the least versus most experienced groups did not yield the greatest number of significant differences. Instead, comparisons between the least versus average experienced groups yielded the greatest number of significant differences.

Among the four skills with significant experience contrasts between the least and average experienced groups, three different functions were represented. These were awareness, jaw opening, and tongue position. For the awareness function, fewer children in the least experienced group held their head steady during swallowing (cracker whole) than children in the average experienced group. For the jaw opening function, fewer children in the least experienced group opened their mouth when the solid was brought to the mouth (cracker whole) and opened their mouth before the spoon touched their lips than children in the average experienced group. For the tongue position function, more children in the least experienced group kept their tongue in their mouth during acceptance of the spoon than children in the average experienced group.

Comparisons between the 10 versus 12-month groups yielded the fewest significant age differences within individual skills. This finding suggests that there may be fewer important changes in skill development between the ages of 10 and 12 months. It is surprising that there were not more significant differences with regard to specific skills between these two age groups as previous studies have reported (Stolovitz & Gisel, 1991).

Between the two skills with significant age contrasts between the 10 versus 12-month groups, two different functions were represented. These were awareness and retrieval. However, the specific skills were different than what was found for the 8 and 12-month groups. Specifically, more children in the 10-month group leaned towards the spoon (textured puree) and used their lips to retrieve a lost bolus than children in the 12-month group. One explanation for this finding is that children in the 10-month group are demonstrating more advanced motor skills relative to children in the 8-month group. By 10 months, children are sitting independently (WHO, 2006) and may be more interested in actively participating in the feeding process. Perhaps by 12 months, the feeding process is less novel and thus less interesting. It is likely that the considerable variability found in overall development within the first year of life contributed to these findings for oral-motor skills.

Like the age findings for the children in the 10 and 12-month age groups, comparisons between the average versus the most experienced groups yielded the fewest significant experience contrasts within individual skills. However, the significant skills and corresponding functions were different for the experience groups than for the age groups.

For the one skill with significant experience contrasts for the average versus most experienced groups, the jaw opening function was represented. Specifically, more children in the average experienced group opened their mouth when the solid was brought to the mouth (cracker piece) than children in the most experienced group.

Like the 10 and 12-month groups, the 8 versus 10-month groups had performance differences only for the awareness and retrieval functions, both of which are closely related to gross motor development. In all cases, fewer children in the 8-month group brought their heads forward to the spoon (smooth puree), leaned towards the spoon, reached for solid (cracker piece),

used their hands and lips to retrieve lost bolus (textured puree and solid) and cleared a lost bolus than children in the 10-month group. These findings suggest that one reason for the differences between children in the 8-month group and children in the 10 and 12- month groups may be related to their less advanced gross motor skill development.

Comparisons between the least versus the most experienced groups yielded performance differences only for the lip closure-object and tongue position functions. This is again surprising because it was predicted the greatest experience differences would reflect the greatest performance differences like the age contrasts. This was not the case for experience. For both contrasts, more children in the least experienced group kept their tongue in the mouth during acceptance and drew in the lower lip after spoon removal than children in the most experienced group. Collectively, findings suggest that there are changes in skill development that appear to be based on experience and may be less tied to chronological age. In addition, findings suggest that there may be some experiential threshold, above which skill acquisition tends to become more uniform.

Differences within textures and within oral-motor skills for age and experience groups. When age within textures and skills was examined, 6 of the 11 skills that showed significant differences among age groups (collapsed across textures) were the same. When experience within textures and skills was examined, more specific differences were identified. However, findings for experience groups differed from those for age. Only three of the same skills (i.e., skills for the tongue remaining in the mouth during acceptance, drawing in of the lower lip after removal of spoon, and holding head steady in midline during swallowing) showed significant differences among groups for both age and experience contrasts. This finding suggests that examination by experience detects different types of performance differences than age. It was

hypothesized that children in the different age and experience groups would perform similarly for earlier introduced textures and differently on more advanced textures, but findings did not completely support this. Interestingly, 66% of the significant age contrasts involved textured puree (TP) and cracker whole (CW) (TP=33% of contrasts; CW=33% of contrasts). As with the age and texture findings, 59% of the significant contrasts involved textured puree (TP) and cracker whole (CW) (TP=23% of contrasts; CW=36% of contrasts). However, unlike the age findings, cracker whole had a higher proportion of significant experience differences than the textured puree. It was not unexpected that the cracker whole had the greatest number of performance differences as this texture is thought to be a more difficult texture to chew and it tends to be introduced at later chronological ages. However, it was surprising that textured puree also had the greatest number of contrasts as this texture is thought to be easy to chew and tends to be introduced at earlier ages, thus nearly all children had some experience with this texture. Only 6% of the significant age contrasts involved smooth puree. It was not surprising the smooth puree had the fewest contrasts as this texture is thought to be easy to manage and is the first texture introduced to infants. As expected, children in this study were introduced to diced solids later than cracker whole. This is interesting because, inconsistent with the hypothesis, only 9% of the significant experience contrasts involved diced solids. It was unpredicted that the solid had the fewest contrasts as this texture is thought to be a more difficult texture to chew and is introduced last (yet the texture with the fewest age contrasts was smooth puree).

With regard to oral-motor functions for age contrasts, findings for age and texture revealed that smooth puree had performance differences from the awareness function; textured puree had performance differences from the awareness and retrieval functions; solids had performance differences from the awareness, retrieval and lip closure-object functions; cracker

piece had performance differences from the awareness function; and cracker whole had performance differences from the awareness, biting, maintenance, and tongue position functions. It is also noteworthy that five additional skills had seven significant texture- specific age contrasts that were not revealed when performance was collapsed across all textures, thus these findings were texture specific as detailed in Table 32.

For smooth puree, there were no additional contrasts beyond those that were significant across textures.

For textured puree, one skill that was not significant for the across textures comparison showed performance differences for the awareness function. Specifically, fewer children in the 8-month group held their head steady during bolus manipulation than children in the 10 and 12-month groups.

For solid, one skill that was not significant for the across textures comparison showed performance differences for the lip closure-object function. More children in the 10-month group removed the bolus with both lips than children in the 12-month group.

For cracker piece, there were no additional contrasts beyond those that were significant across textures.

For cracker whole, three skills that were not significant for the across textures comparison showed performance differences for the maintenance and tongue position functions. Fewer children in the 8-month group maintained bolus during swallowing than children in the 10-month group. Fewer children in the 8-month group kept their tongue in the mouth during bolus manipulation than children in the 12-month group and fewer children in both the 8 and 10-month groups kept their tongue in the mouth while pushing the bolus backwards than the 12-month group.

With regard to oral-motor functions for experience contrasts, findings for experience and texture revealed that smooth puree had performance differences from awareness, maintenance, and retrieval functions; textured puree had performance differences from jaw movement, lip closure-manipulation, and maintenance functions; solid had performance differences from lip closure-swallow and retrieval functions; cracker piece had performance differences from jaw opening, lip closure-object, and tongue position functions; and cracker whole had performance differences from awareness, biting, chewing, jaw opening, and maintenance functions. With regard to previous experience findings for skills across texture, only two skills that showed significant experience differences across textures also showed significant differences within at least some of the textures. The functions with significant skills for age and experience groups and texture are detailed in Table 32.

It is also noteworthy that 14 additional skills had 19 significant texture- specific contrasts that were not revealed when performance was collapsed across all textures. Thus, these findings were texture specific.

For smooth puree, three skills that were not significant for the across textures comparison showed performance differences for the awareness, maintenance, and retrieval functions. More children in the least experienced group reached towards the spoon than children in the average experienced group. Fewer children in the average experienced group did not have food outside of the mouth after acceptance and used their hand to wipe bolus outside of their mouth than children in the most experienced group.

For textured puree, three skills that were not significant for the across textures comparison showed performance differences for the jaw movement, lip closure-manipulation, and maintenance functions. More children in the least experienced group used up and down jaw

movement with bolus in mouth than children in the most experienced group. More children in the least and average experienced groups maintained lip closure throughout bolus manipulation than children in the most experienced group. Fewer children in the least and average experienced groups did not have food outside of the mouth after acceptance than children in the most experienced group.

For solid, two skills that were not significant for the across textures comparison showed performance differences for the lip closure-swallow and retrieval functions. Fewer children in the average experienced group kept lips closed during swallowing than children in the most experienced group. Fewer children in the least experienced group used their tongue to retrieve a bolus than children in the average experienced group.

For cracker piece, three skills that were not significant for the across textures comparison showed performance differences for the lip closure-object and tongue position function. More children in the average experienced group used the lower lip to touch the bottom of the solid and both lips touched the solid than children in the most experienced group. More children in the average experienced group did not use repetitive forward/backward tongue movement during bolus manipulation than children in the most experienced group.

For cracker whole, five skills that did not show significant differences for the across textures comparison showed performance differences for the awareness, biting, chewing, and maintenance functions. Fewer children in the least experienced group turned head towards solid, reached towards solid, took bites in the front of the mouth and maintained bolus during the swallow than children in the average experienced group. More children in the average experienced group initiated chewing after the bolus entered the mouth and maintained bolus during swallow than children in the most experienced group.

Summary of performance differences between age, experience, and texture.

Several interesting findings were noted in the comparison between age and experience groups. In general, there were more differences in performance between age groups than experience groups. For age groups, there were more significant differences in performance for children who were further apart in age for certain skills, but not for all skills. For experience groups, there were more significant differences in performance for children with less overall experience for certain skills, but not for all skills. Specifically, findings of the present study suggest that most of the performance differences among children at 8, 10, and 12 months are for skills related to awareness/gross motor and retrieval functions, both across and within textures. This is interesting because children are acquiring important gross motor skills in the first year of life (WHO, 2006), and findings support the longstanding clinical observation that these skills may impact or are at least related to developmental acquisition of feeding skills. This could mean that acquisition of certain gross motor skills might be a prerequisite for development of certain oral-motor skills for feeding. This concept is certainly not novel to most clinicians and supports current clinical practice. However, providing an evidence-base and a means for quantification of current clinical practice is vital for appropriate care of children with feeding problems.

Findings of the present study suggest that most of the performance differences among children of different experience groups across texture were for skills related to jaw opening and tongue position functions. This is quite different than findings for age. The experience findings suggest that movements of the jaw and tongue may be more affected by experience with feeding than chronological age. That is, children seem to acquire feeding- specific oral-motor skills via experience, and they acquire more general feeding-related skills via age. Also, the performance

differences among children of different experience groups within texture were more diverse as they were related to 11 of the 12 functions (versus only 6 of 12 functions for age findings (across and within textures)). Findings suggest that experience is an important factor in skill development and that there may be some threshold of experience that is distinct from chronological age. It would seem that certain oral-motor skills reveal age differences associated with other domains of development (e.g., gross motor development) and that the difference in the amount of early experience may have a greater impact on acquisition of feeding-specific oral-motor skills (i.e. movements of tongue and more complicated movements of the lips and jaw during chewing and swallowing). Interestingly, however, all of these oral-motor skills and their corresponding functions for age and experience belong to the acceptance phase of the feeding process or to maintenance/retrieval of the bolus. Skills with performance differences occur at the lips or outside of the mouth. There are several possible explanations. First, skills related to the acceptance phase are the first to develop over the more refined skills potentially required for bolus manipulation and swallowing. In addition, skills of the acceptance phase rely primarily on jaw control (opening and closing phases) versus the more complex lip and tongue movements required for bolus manipulation. Another explanation is that skills associated with acceptance and maintenance/retrieval of the bolus were more readily observed clinically and subtle differences in performance associated with bolus manipulation and swallowing may not be detected with binomial scoring of skills.

Another confounding factor when examining age and experience alone is the variability associated within texture that was obscured when collapsing across all textures. As with the age-only skill contrasts, age and texture contrasts had a larger proportion of oral-motor skills from the awareness function and only five other functions with significant contrasts. The chewing, jaw

movement, jaw opening, lip closure-manipulation, lip closure swallow, and tongue movement function were without any age and texture contrasts. Interestingly, the tongue movement function was the only function without any significant experience and texture contrasts. These findings suggest that age may be a better indicator of the motor actions used to demonstrate awareness of food presentation and that experience may be a better indicator of true oral-motor skill development.

Findings from this study have several potential clinical implications. If age is more sensitive to maturational processes and precursor motor skills, and experience is more sensitive to actual learning of oral-motor skills, current clinical practice may need to be altered. Clinicians already evaluate oral-motor skill development for feeding within the context of general development. Standard practice also incorporates observation of skills for several textures (if possible based on a child's age and current diet). However, other factors may need to be considered further during a clinical feeding evaluation. In particular, perhaps clinicians should consider that age is but one variable related to oral-motor skill performance. Experience-related development may also warrant careful consideration. Clinicians need to use the best evidence-base when making clinical decisions. Further work in this area will better define which gross and fine motor skills might be prerequisites for subsequent oral-motor skill development. In addition, these findings reveal particular oral-motor skills that appear sensitive to detecting differences in development. However, a greater number of differences between age groups was expected. This lack of differences might reflect that these target skills are not sensitive enough to detect differences or that other differences simply do not exist.

Mastery of oral-motor skills by age and experience

The effect of children's age and experience on oral-motor skill emergence and mastery was also of interest. With regard to the question of when each oral-motor skill first emerges and then is mastered, the following operational definitions were employed. Emergence of an individual oral-motor skill was determined when 50 - 74% of children within a group performed the skill and mastery of an individual oral-motor skill was determined when 75% or more of children within a group performed the skill. These percentile and quartile criteria have been used in previous literature examining acquisition of speech sounds (Templin, 1957), gross motor milestones (WHO, 2006) and general development (Frankenburg & Dodds, 1990).

Although all children had limited experience with feeding of solids due to their young age, there was considerable variability among children with regard to when they were first introduced to solid foods in general, and when they were introduced to specific textures. Although the average amount of experience for each texture increased with age, the range was substantial. For example, there were as few as six weeks and as many as 29 weeks difference in the amount of experience children had on a particular texture within any given age group. It was expected that this considerable variability in experience would have an important impact on skill acquisition and mastery.

Emergence and mastery within textures and across all oral-motor skills for age and experience groups at each quartile performance level. When data were examined within texture but collapsed across skills for each age and experience group, it was hypothesized that there would be diversity in the proportions of skills performed at each performance level. It was also hypothesized that the older and more experienced children in this study would have a greater proportion of mastered skills than the younger and less experienced children and that earlier

introduced textures would have a higher proportion of mastered skills than more advanced textures. Findings did not support these hypotheses.

For the three age groups, the smallest proportion of skills was observed at the 25 – 49% and the 50 – 74% levels. There was one exception to this finding as the 12-month group had the smallest proportion of skills performed at the 0 - 24% level versus the 50 – 74% level. This finding suggests a slight advancement in development for the 12-month group as they had fewer skills performed at the lowest performance level as compared to the 8 and 10-month groups.

For the three experience groups, the smallest proportion of skills was performed at the 25 – 49% and the 50 – 74% levels for children in the least experienced group, but this was not the case for the average and most experienced groups. For the average experienced group, the smallest proportion of skills was performed at the 25 – 49% level with an equal proportion (and greater proportion) of skills performed at the 0 – 24% and the 50 – 74% levels. For the most experienced group, the smallest proportion of skills was performed at the 0 – 24% and 25 – 49% levels. This again suggests a developmental shift for children in the most experienced group as it did for children in the 12-month age group.

The performance level with the greatest proportion of skills observed for all age and experience groups was the mastery level. The average percent of skills performed at mastery level was 67% across age groups (8 months=66.8%; 10 months=67.9%; and 12 months=66.2%) and 62% across experience groups (least experienced=63.5%; average experienced=59.6%; and most experienced=63.5%). These findings are surprising as it was expected that older and more experienced children would have a greater proportion of mastered skills. Overall, there was less diversity than expected across the performance levels and age and experience groups. In fact, when looking at skill acquisition across performance levels, it is even more apparent that there

were more similarities than differences among children in the different age and experience groups.

Inconsistent with the hypothesis that earlier introduced textures would yield a greater proportion of mastered skills than the more advanced textures, the cracker textures (i.e., cracker piece (CP) and cracker whole (CW)) had the highest proportion of mastered skills for both age and experience groups. The average proportion of skills performed at mastery level was 70% across all age groups (CP=70.7%; CW=69.4%) and 71% across all experience groups (CP=73.2%; CW=69.4%). Smooth puree (SP), textured puree (TP), and diced solid (S) had the lowest proportion of skills performed at mastery level. The average proportion of skills performed at mastery level for these textures across all age and experience groups was 62% (Age: SP=62.8%; TP=60%; S=62.2%; Experience: SP=62.8%; TP=60%; S=62.2%). These findings support previous research (Stolovitz & Gisel, 1991) demonstrating that children perform better on solid textures than on pureed textures. One explanation might be that solid textures provide more sensory feedback to aid in oral movements and bolus manipulation.

Emergence and mastery within textures and within oral-motor skills for age and experience groups at each quartile performance level. When data were examined within textures and within individual skills for age and experience groups, more similarities were identified. Of the 52 target skills, there were 24 common skills mastered for the three age groups and the same 24 common skills were also mastered for all textures. This means that 75% or more of all children, regardless of their age and the texture eaten, mastered 24 (46.2%) of the 52 target skills. There were no common emerging skills identified.

Of the 52 target skills, there were 21 common skills mastered for the three experience groups and the same 21 common skills were also mastered for all textures. This means that 75% or more of

all children, regardless of their experience and the texture eaten, mastered 21 (40.4%) of the 52 target skills. There were no common emerging skills identified.

Summary of emergence and mastery between age, experience, and texture

This study found that a similar proportion of skills was mastered regardless of age, experience, or texture. That is, a robust developmental progression of differences in skill performance by age or experience was not found in this study. This group of typically developing children often performed oral-motor skills similarly regardless of their age or experience. There was performance variability within and between groups, but in spite of this, it was found that most of the children in this study had already acquired many of the oral-motor skills thought to be important for successful feeding. Surprisingly, of the 24 skills mastered regardless of age or texture and the 21 skills mastered regardless of experience or texture, the same 21 of the 52 oral-motor skills were mastered regardless of age, experience or texture. These findings have implications for clinical care of a child with a potential feeding problem. Children as young as 8 months mastered a similar number of common skills as 12-month-old children. As unexpected as the age and experience findings, children performed a greater number of skills at mastery level for presumably one of the most difficult textures (cracker whole) and not on what is assumed to be one of the easiest textures (smooth puree). It is noteworthy that 19 additional skills were mastered for specific textures regardless of age or experience and nine oral-motor skills did not meet emergence or mastery criteria regardless of age, experience or texture.

This study found that 21 oral-motor skills for feeding seem to be an important reflection of development for children between the ages of 8 and 12 months. There may be other skills that

reflect important developmental changes and the skills that were not mastered may simply be too difficult to measure by clinical assessment. However, even with this crude measurement technique, differences showed through.

A total of 10 different skills had significant performance differences that were also considered part of the 21-mastered skills. That is, some skills considered mastered by our performance criteria showed significant differences in performance by age or experience. Thus, even when 75% or more of children in a group performed a skill, significant performance differences between groups occurred on certain skills. For age groups, only four of the 16 contrasts with differences between groups were performed at mastery level. However, for experience groups, nearly all of the contrasts (six of the seven) with performance differences between groups were performed at mastery level (the seventh skill was performed at emergence level). This observation may reduce the importance of the statistical differences that were observed between experience groups as most of the children in the group were performing at mastery level.

Functions. In order to better understand these mastered skills, the functions related to skills were examined. Of the 21-mastered oral-motor skills, the skills came from seven different functions.

There were 5 (24%) oral-motor skills from the awareness function (turns head to solid or utensil, looks at solid or utensil, holds head steady during acceptance/bolus manipulation/swallowing). Consistent with previous findings, children visually recognized the spoon by six months (Morris, 1982). No data were found for the other awareness skills.

There were 4 (19%) oral-motor skills from the jaw opening function (opens mouth when solid or utensil is brought to mouth, jaw opens vertically in midline, opens mouth before solid or

spoon touches lips, and mouth opens enough for solid or utensil to enter mouth). Consistent with previous findings, children opened their mouth as the spoon approached and before the spoon touched their lips (Carruth & Skinner, 2002; Morris, 1982). Inconsistent with previous findings, children in this study demonstrated a consistent amount of opening for the spoon or solid (across children regardless of texture) even though it was reported that children had a variable amount of jaw opening until 12 months age (Morris & Klein, 1987; 2000). No differences were found for the other jaw opening skills.

There were 3 (14%) oral-motor skills each from the biting function (gums or teeth contract solid, bites in front of mouth, attempts to bite instead of only tasting or licking) and maintenance function (no bolus loss during acceptance/bolus manipulation/swallowing). Consistent with previous findings for biting, children did contact the solid between the gums or teeth and attempted to bite through a cracker as early as eight months (Morris, 1982). Inconsistent with previous findings for maintenance, bolus maintenance was mastered for all ages even though it was reported that bolus maintenance was not demonstrated until 12 months for purees and 18 months for solids (Morris, 1982).

There were two (10%) oral-motor skills each from the lip closure-object function (bolus removed from spoon with both lips and solid or utensil removed from mouth without resistance), tongue movement function (no assistance from fingers to move bolus inside of mouth and no repetitive up/down tongue movements during bolus manipulation), and tongue position function (tongue remains in mouth while solid or utensil enters and no repetitive forward/backward tongue movement during bolus manipulation). Consistent with previous findings for lip closure-object, by eight months of age children used full lip occlusion on the spoon on 80% or more of puree trials and 76% or more of solid trials (Stolovitz & Gisel, 1991). Previous findings also

report removal of the spoon without biting on 77% of all texture trials (Stolovitz & Gisel, 1991). Inconsistent with previous findings for tongue movement, children in the present study tended to use their tongue instead of the fingers to move the bolus in their mouth even though other studies reported that children between 8 and 10 months continued to use their fingers to assist in bolus movement (Carruth & Skinner, 2002). Also inconsistent with previous findings, children did not use repetitive up/down tongue movements during bolus manipulation, which was described to persist at 15 months of age (Morris, 1982). Somewhat consistent with previous findings, repetitive forward/backward tongue movement to accept a bolus was extinguished by 6 to 9 months (Morris, 1982; Reilly, 1985; Stolovitz & Gisel, 1991) and this pattern was also extinguished for children in this study.

All phases of the feeding process had mastered skills. However, skills related to awareness, jaw opening to accept a bolus, and maintenance of a bolus were the primary functions mastered for these age and experience groups. These skills are part of the acceptance phase of the feeding process. Functions without any mastered skills included the chewing, jaw movement, lip closure-manipulation, lip closure-swallowing, and retrieval functions. These skills are primarily associated with the bolus manipulation and swallowing phases of the feeding process.

Findings support the suggestion that skills in the acceptance phase are the first to be mastered by children. Clinically, skills related to the acceptance phases are easier to observe directly than skills related to bolus manipulation and swallowing. It is difficult to discern if this finding suggests that bolus manipulation and swallowing skills cannot be observed and scored (primarily due to lip closure) or if these the way these skills were measured (via clinical observation with dichotomous scoring) was simply not sensitive enough to detect differences.

However, the majority of skills observed in this study comprising the bolus manipulation and swallowing phases of the feeding process are skills related to jaw movement, tongue position outside of mouth, and lip positioning. All of these skills can be viewed even if the lips were closed. Overall, findings support current practice that direct clinical observation can identify certain differences in oral-motor performance for very young children without the need for instrumentation and exposure to radiation.

Study limitations

There are a number of limitations to the present study. These include: behavioral compliance (i.e., no control for order of texture presentation; different foods given within texture, bolus size of cracker whole and solid); scoring challenges; experience versus practice; limited number of age groups and children; and oral-motor skills. Each of these limitations is elaborated below.

Obtaining behavioral compliance for infants is both complicated and challenging. Attempting to obtain compliance when studying infants plays a major role in all of the other limitations. Obvious cognitive immaturity limits the ability to ask children to sit still or keep their hands away from their face. Often children refuse or expel food presentations based on mood, not because they are unable to manage the food. Also, a standard order of texture presentation was not employed in this study, but rather order of texture presentation was based on each child's typical routine. Parents were allowed to choose any order of texture presentation to increase the likelihood of acceptance and compliance. Although texture was controlled, parents were able to choose different foods within the texture category. Different smooth pureed foods have varying thicknesses that may alter oral-motor performance. Control of the bolus size

was attempted by use of the same spoon for all children and trials; however, parents presented different sized diced solids and children took different sized bites from the cracker.

Certain textures present unique situations for scoring oral-motor skills, particularly the cracker trials. The majority of children fed themselves the cracker and they often held their hand in front of their mouth while accepting and often during manipulation of the bolus. Another obstacle is that many children took subsequent bites prior to completing the first bite, which increased scoring difficulty for swallowing skills. Several rules were created to accommodate for these situations (as these situations are not unlike typical clinical experience). Another obstacle is that despite instructions, parents had a difficult time inhibiting their reflex to "catch" a lost bolus and would often re-present it to the child; or they often would scrape the bolus onto the upper lip instead of allowing the child to use the lips to clear the spoon. In these cases, another trial was presented. Children frequently moved from their baseline position, turned away from the camera, moved their arms, reached, clapped, or banged on their tray during a mealtime, each of which limited visibility of the oral structures for scoring. Such problems are inherent in most research involving infants.

Another confounding factor is that of experience versus practice. Children were regrouped based on the amount of experience they had with each texture. However, the amount of experience was simply the amount of time from the first presentation to the time of data collection. How often they practiced (i.e., how frequently they were given the opportunity to eat foods within each group) prior to data collection was not controlled and could play a major role in performance. In addition, statistical power was lower for experience analyses as the number of children per experience group was not controlled and varied for each texture. Of particular note is that for some analyses, the most experienced group contained as few as 4 children.

One of the most important limitations of this study is that only three age groups, comprised of a total of 63 children, were studied for this project. In comparison to the literature, this is the second largest observational study to date. However, given that there is a wide range of variability in early development, the study of a much larger number of children within each age group is imperative. Some of the unusual findings from the 12-month group may simply be due to general developmental variability that would be alleviated by studying a larger number of children. Since children as young as 8 months mastered the same skills as the older children in this study, examining children between 4 and 8 months is necessary to better understand when these skills are actually acquired. Although the recommended age of introduction to first solids is six months, this study found that children were often introduced to first foods at much younger ages, providing an opportunity to examine earlier skill development.

An extensive process employing review of the literature and expert validation procedures was used to identify oral motor skills that were clinically important and that could be scored by clinical observation. The surprising lack of differences among age and experience groups both within and across textures for different skills may suggest that the skills examined in this study are not sensitive to developmental differences. Conversely, it may be that there simply are not important developmental differences among children between the ages of 8 and 12 months of age. Another possibility is that binomial judgments of the presence or absence of individual skills may have masked the variability among children with regard to how well they performed each skill. Further, there may be certain skills in this set that are difficult for the human eye to detect, or to score reliably; such skills may require instrumentation to measure. In addition, there may be other skills that were not included in the set used in the present study which are important for the identification of developmental differences. In general, caution should be used

in interpretation of these findings until a larger sample size is studied and until further analyses are completed regarding the reliability of observations of these skills.

Clinical implications

Children develop and acquire important oral-motor skills during the first year of life. However, findings suggest that acquisition of the specific oral motor skills examined in this study may plateau, showing few developmental changes, between the ages of 8 and 12 months. Indeed, findings suggest that children perform a greater number of oral-motor skills on a variety of textures at younger ages than previously thought. Why did these results occur? The advantages of this study were that a relatively large sample size was employed compared to extant literature, although as noted above, the sample was still quite small. An objectively defined skill set was evaluated across a number of situations (i.e., several different textures) and methodological issues from previous studies were remediated.

Findings provide preliminary support for the use of the target 52 oral-motor skills assessed via clinical observation. In particular, the findings of this study demonstrate that there are 21 core oral motor skills on which children between the ages of 8 and 12 months of age should demonstrate mastery. Assessment of these skills may prove useful for identifying children with early feeding problems. Further study examining differences between young children with known feeding disorders and children who are typically developing may provide important information regarding the potential predictiveness of the 21 core skills.

It is suspected that children at younger ages are more likely to show more robust developmental progressions of skill acquisition, but several questions arise when looking at these core skills mastered by this group: What happens between 4 and 8 months of age? When do

these skills emerge? Do these skills emerge slowly over several months or quickly? Is there a specific window of time when children are hard-wired to acquire these skills? Is learning more difficult after that window is closed? Does experience with purees predispose children to learn other skills? As with any study, as some questions are answered, other questions arise.

The question of predisposition to task is interesting. Sucking is innate for most children early in life (Delaney & Arvedson, 2008). However, children introduced to textured food after 10 months have been reported to have more difficulty with feeding than those introduced earlier (Northstone, Emmett, & Nethersole, 2001). Based on this knowledge and the findings of the present study, it is possible that there is a window of time when children are more predisposed to develop and acquire certain oral-motor skills for feeding. Further, the present study provides evidence that certain gross motor skills may be related to certain feeding skills. Clinicians have long been aware that general development, particularly in gross and fine motor domains, impacts feeding. However, research documenting this relationship has been limited.

Findings of the present study suggest that different types of oral-motor skills are impacted by experience rather than age. Motor learning theory suggests that there is increased variability in skill performance with less experience and reduced variability and increased stability of performance with more experience (Clark, Robin, & McCullagh, 2001; Magill, 2006; Robbins & Klee, 1987). Based on this theory and the findings of the present study, experience may provide a unique basis for skill development and performance. Does performance of skills for one texture predict performance of skills for another, particularly for the 21-mastered skills? If this thought is true, how early could more textured foods be introduced?

Findings of the present study suggest that earlier introduction of textured foods may be warranted. The behavioral and developmental literature suggests that earlier introduction of

textures may be beneficial because memories of unpleasant experiences (i.e., gagging) that are typical during feeding development would be less likely to imprint in children's memory. Manikam & Perman (2000) suggested that food preference is shaped through early experience and that negative oral experiences early in life can lead to food aversion learning. Younger infants would be less aware of the negative experience and thus less likely to develop a feeding aversion marked by crying, gagging vomiting, turning head away, and batting at food.

Comparison of oral skills in typically developing children to a group of children with feeding disorders is necessary. Comparison to a group of children with early feeding and / or growth problems would help to determine what oral-motor profiles are true indications of feeding problems and how growth and nutrition are affected. It will also help to identify what red flags or clinical markers may predispose a child to have increased difficulties in the future. As caution in interpretation is recommended due to the exploratory nature of this study, it is clear that a much larger sample size is needed to verify these findings and to answer these questions. Additionally, item / skill specific reliability and analyses should be examined to help to validate these skills. Specifically, the number and types of skills examined could be refined and narrowed. Potentially, certain textures could be determined to be more useful in identification of differences than others, again refining the number of variables in an assessment.

Several factors were confirmed and may prove to be markers helpful to a clinician evaluating a child. This study confirmed that children should be studied and evaluated as they take varying textures of foods. Possibly, the textured puree and cracker whole textures should be primary textures evaluated, as performance on those textures was most different by age and experience. Biting through the cracker was a clear marker for development across ages. And finally, the 21 core skills could be expected to be performed by children as young as eight

months of age. Much work remains to standardize a clinical assessment tool for infant oral-motor skills for feeding.

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.

Alexander, R., Boehme, R., & Cupps, B. (1993). *Normal Development of Functional Motor Skills*. San Antonio: Therapy Skill Builders.

Arvedson, J. C., & Brodsky, L. (2002). *Pediatric Swallowing and Feeding: Assessment and Management* (Second ed.). Albany: Singular Publishing Group.

Arvedson, J. C., & Lefton-Greif, M. A. (1998). *Pediatric Videofluoroscopic Swallow Studies: A Professional Manual with Caregiver Guidelines*. San Antonio: Communication Skill Builders.

Bosma, J. F. (1986). Development of Feeding. *Clinical Nutrition*, 5(5), 210-218.

Carruth, B. R., & Skinner, J. D. (2002). Feeding behaviors and other motor development in healthy children (2-24 months). *Journal of the American College of Nutrition*, 21(2), 88-96.

Chigira, A., Kazuhiko, O., Mukai, Y., & Kaneko, Y. (1994). Lip closing pressure in disabled children: a comparison with normal children. *Dysphagia*, 9, 193-198.

Clark, H.M., Robin, D.A., & McCullagh, G. (2001). Motor control in children and adults during a non-speech oral task. *Journal of Speech and Hearing Research*, 44:1015-1025.

Dahl, M., & Kristiansson, B. (1987). Early feeding problems in an affluent society IV. Impact on growth up to two years of age. *Acta Paediatrica Scandinavica*, 76, 881-888.

Delaney, A.L., & Arvedson, J.C. (2008). Development of Swallowing and Feeding: Prenatal through first year of life. Developmental *Disabilities Research Reviews*, 14, 105-117.

Dodds, W. J. (1989). The Physiology of Swallowing. *Dysphagia*, 3, 171-179.

Dodds, W. J., Stewart, E. T., & Logemann, J. A. (1989). Physiology and radiology of the normal oral and pharyngeal phases of swallowing. *American Journal of Radiology*, 154, 953-963.

Drewett, R., & Young, B. (1998). Methods for the analysis of feeding behaviour in infancy: sucklings. *Journal of Reproductive and Infant Psychology*, 16, 9-26.

Frankenburg, W. K., & Dodds, J. B. (1990). *Denver II Developmental Screening Test* (Second ed.). Denver: Denver Developmental Materials Inc.

Gesell, A., & Ilg, F. L. (1937). *Feeding Behavior of Infants.* J.B. Lippincott Company.

Gisel, E. G. (1991). Effect of food texture on the development of chewing of children between six months and two years of age. *Developmental Medicine & Child Neurology*, 33, 69-79.

Green, J. R., Moore, C.A., Ruark, J.L., Rodda, P.R., Morvee, W.T., and VanWitzenburg, M.J. (1997). Development of Chewing in Children from 12 to 48 Months: Longitudinal Study of EMG Patterns. *Journal of Neurophysiology*, 77, 2704-2716.

Hiiemae, K. M., & Palmer, J. B. (2003). Tongue movements in feeding and speech. *Critical Reviews in Oral Biology and Medicine*, 14(6), 413-429.

Illingworth, R. S., & Lister, J. (1964). The critical or sensitive period, with special reference to certain feeding problems in infants and children. *The Journal of Pediatrics*, 65, 839-848.

Kennedy, J. G., & Kent, R.D. (1985). Anatomy and physiology of deglutition and related functions. *Seminars in Speech and Language*, 6(4), 257-273.

Kenny, D. J., Koheil, R. M., Greenberg, J., Reid, D., Milner, M., Moran, R., & Judd, P. (1989). Development of a Multidisciplinary Feeding Profile for children who are dependent feeders. *Dysphagia*, 4, 16-28.

Kumin, L., & Bahr, D. C. (1999). Patterns of feeding, eating, and drinking in young children with Down Syndrome with oral motor concerns. *Down Syndrome Quarterly*, 4(2), 1-8.

Logemann, J. A. (1998). *Evaluation and Treatment of Swallowing Disorders* (Second ed.). Austin: Pro-Ed, Inc.

Magill, R.A. (2006). *Motor Learning and Control: Concepts and Applications*. (8th ed.). McGraw-Hill Companies.

Manikam, R. & Perman, J.A. (2000). "Pediatric feeding disorders." *Journal of Clinical Gastroenterology* 30: 34-46.

Matson, J. L. & Kuhn, D.E. (2001). Identifying feeding problems in mentally retarded persons: development and reliability of the screening tool of feeding problems (STEP). *Research in Developmental Disabilities*, 21, 165-172.

Mizuno, K., & Ueda, A. (2005). Neonatal feeding performance as a predictor of neurodevelopmental outcome at 18 months. *Developmental Medicine and Child Neurology*, 47, 299-304.

Moore, C.A. (1993). Symmetry of mandibular muscle activity as an index of coordinative strategy. *Journal of Speech and Hearing Research*, 36(6), 1145-1157.

Moore, C.A. & Ruark, J.L. (1996). Does speech emerge from earlier appearing motor behaviors? *Journal of Speech and Hearing Research*, 39, 1034-1047.

Morris, S. E. (1982). *Pre-Speech Assessment Scale*. Clifton: J.A. Preston Corporation.

Morris, S. E. (1985). Developmental Implications for the management of feeding problems in neurologically impaired infants. *Seminar in Speech and Language*, 293-314, New York: Thieme Inc.

Morris, S. E. (1991). *A Profile of the Development of Oral-Motor Skills in Early Infancy-Birth to 12 Months* [Manual]. Faber, VA.

Morris, S. E., & Klein, M. D. (1987). *Pre-Feeding Skills*: Therapy Skill Builders.

Morris, S. E., & Klein, M. D. (2000). *Pre-Feeding Skills* (Second ed.): Therapy Skill Builders.

Northstone, K., Emmett, P., Nethersole. (2001). The effect of age of introduction to lumpy solids on food eaten and reported feeding difficulties at 6 and 15 months. *Journal of Human Nutrition and Dietetics*, 14, 43-54.

Pinder, G. L., & Faherty, A. S. (1999). Issues in Pediatric Feeding and Swallowing. In A. Caruso & E. Strand (Eds.), *Clinical Management of Motor Speech Disorders in Children,* 281-318, New York: Thieme Medical Publishers, Inc.

Pridham, K. F. (1990). Feeding behavior of 6- to 12-month-old infants: Assessment and sources of parental information. *The Journal of Pediatrics*, 117(2, Part 2).

Reilly, S., Skuse, D., Mathisen, B., & Wolke, D. (1995). The objective rating of oral-motor functions during feeding. *Dysphagia*, 10, 177-191.

Reilly, S., Skuse, D., & Wolke, D. (2000). *Schedule for Oral Motor Assessment* (SOMA): Whurr.

Robbins, J. & Klee, T. (1987). Clinical assessment of oropharyngeal motor development in young children. *Journal of Speech and Hearing Disorders*. 52(3):271-277.

Rogers, B., & Arvedson, J. C. (2005). Assessment of Infant Oral Sensorimotor and Swallowing Function. *Mental Retardation and Developmental Disabilities Research Reviews*, 11, 74-82.

Rommel, N., De Meyer, A., Feenstra, L., & Veereman-Wauters, G. (2003). The complexity of feeding problems in 700 infants and young children presenting to a tertiary care institution. *Journal of Pediatric Gastroenterology and Nutrition*, 37, 75-84.

Skuse, D., Stevenson, J., Reilly, S., & Mathisen, B. (1995). Schedule for Oral-Motor Assessment (SOMA): Methods of Validation. *Dysphagia*, 10, 192-202.

Steeve, R., Moore, C., Green, J., Reilly, K. & McMurtrey, J. (2008). Babbling, chewing and sucking: oromandibular coordination at 9 months. *Journal of Speech and Hearing Research*, 51, 1390-1404.

Stevenson, R., & Allaire, J. H. (1991). The development of normal feeding and swallowing. *Pediatric Clinics of North America*, 38(6), 1439-1453.

Stolovitz, P., & Gisel, E. G. (1991). Circumoral movements in response to three different food textures in children 6 months to 2 years of age. *Dysphagia*, 6, 17-25.

Stratton, M. (1981). Behavioral Assessment Scale of Oral Functions in Feeding. The *American Journal of Occupational Therapy*, 35(11), 719-721.

Templin, M.C. (1957). Certain language skills in children (Monograph Series No. 26). *Minneapolis: University of Minnesota, The Institute of Child Welfare*.

WHO Multicentre Growth Reference Study Group. WHO Motor Development Study: Windows of achievement for six gross motor development milestones. (2006). *Acta Paediatrica*, 450, 86-95.

Wilson, E. M. (2005). Kinematic Description of Chewing Development. *University of Wisconsin-Madison, Madison*

Appendix A: Minimum and maximum ages of mastery for each oral-motor skill for the PSAS (Morris, 1982).
Pre-Speech Assessment Scale (1982): all possible items to score; age range of mastery in months from minimum age observed to maximum age observed in months; and age when 2/3 of sample mastered skill (Total=6)

FEEDING BEHAVIOR	*MIN: Age mastered*	*MAX: Age mastered*	*2/3 of 6 kids*
Sucking			
Unstabilized jaw movement with the cup	4	7	5
External jaw stabilization through biting on cup	11	24	variable
Internal jaw stabilization through muscle co-activation	18	36	36
Jaw separates from the tongue in sucking	7	11	11
Cupped grooving of the tongue during sucking	0	1	0
Extension-retraction suckle with bottle or breast	0	3	1
Extension-retraction suckle with the cup	4	6	5
Extension-retraction suckle with the spoon	1	6	2
Up-down suck pattern of the tongue with bottle or breast	5	9	9
Up-down suck pattern of the tongue with the cup	5	11	8
Up-down suck pattern of the tongue with the spoon	7	12	11
Quieting or inhibition of jaw and tongue movement as child anticipates entrance of the spoon	4	7	6
Cleans lips with tongue with up-down and sweeping motions	12	36+	36
Liquid loss with bottle or breast	0	1	0
Upper lip comes forward and down to assist in cleaning food from spoon	5	8	7
Lower lip draws inward after spoon removal	4	12	7
Lower lip draws inward and food is cleaned or retrieved from it by upper incisors	9	21	15
Swallowing			
Suckle-swallow protrusion of tongue with liquids	0	2	1
Suckle-swallow protrusion of tongue with semi-solids	1	6	2
Simple tongue protrusion with liquids	4	11	11
Simple tongue protrusion with semi-solids	2	?	12
Simple tongue protrusion with solids	5	9	7
Elevated tongue with jaw separation for liquids	8	36+	11
Elevated tongue with jaw separation for semi-solids	10	36+	11
Elevated tongue with jaw separation for solids	7	36+	11
Lip closure in swallowing liquids	0	11	11
Lip closure in swallowing semi-solids	1	9	8
Lip closure in swallowing solids	7	?	18
Liquid loss during sucking and swallowing of liquids from a cup	4	6	5

Food or saliva loss in sucking and swallowing pureed foods	1	6	1
Suck-swallow transition poorly coordinated with breathing: i.e., coughing and choking with cup	5	?	11
Continuous sucks from the cup; poorly coordinated w/swallowing	5	6	5
Takes 1-3 sucks from the cup and stops or pulls back	6	8	8
Suck-swallow sequences greater than 3 sucks with intake of 1 oz. or more of liquid	9	15	15
Biting and Chewing			
Uses sucking or suckling only for biting	4	5	5
Uses a phasic bite-release with no or minimal bite through with soft cookies	5	9	variable
Uses phasic bite-release with no or minimal bite-through for hard cookie or large pretzel	6	19	variable
Controlled bite on soft cookie	7	12	11
Controlled bite on hard cookie or large pretzel	11	24	18
Head extension or other associated movement with soft cookie	7	11	variable
Head extension or other associated movement with hard cookie or large pretzel	10	18	variable
No chewing. Sucking or suckling only with food	4	5	variable
Stereotyped phasic bite and release pattern in chewing	5	9	variable
Non-stereotyped variable vertical chewing pattern of the jaw	5	11	8
Diagonal-rotary pattern of the jaw to the side of food placement	5	9	8
Circular-rotary pattern of the jaw in transferring food across midline	24	36+	36
Extension-retraction movements of the tongue mixed with chewing	5	?	7
Munching	5	9	6
Tongue lateralization with food placement on the side	5	9	7
Tongue lateralization and transfer of food from the center to both sides	7	12	8
Tongue lateralization transferring food from one side to the other across midline	21	36+	24
Tongue transfers food from right-to-left and left-to-right across midline	21	36+	36
Tongue tip separates from jaw and elevates to clean the lips or buccal cavity	18	36+	36
Tongue separates from jaw and moves the food laterally while the jaw remains in midline	12	36	24
Lips are active with the jaw and make some mechanical contact during chewing	5	9	9
Upper lip moves actively forward and down during chewing	8	12	9
Upper and lower lip is drawn actively inward during chewing	5	9	7
The corner of the lip or cheek is drawn actively inward during chewing	8	11	11
Cheeks are used actively to control or move the food	8	18	11
Upper incisors are used to clean or retrieve food from the lower lip during chewing	8	12	12
Cleaning movements are smoothly integrated with chewing	11	36	24
Chews with lips closed	9	?	18
Does not lose food or saliva during chewing	12	36	24

Appendix B: Age-specific oral-motor skills for the PSAS (adapted from Morris, 1982)

Feeding Behavior Category Age (mo)	Oral-motor skill description
SUCKING	
Sucking: Liquids from the cup	
6	Child uses primarily a suckling pattern or a mixture of sucking and suckling Extension-retraction motion of the tongue is observed in drinking or as cup is inserted or removed Jaw movement is a wide up-down or backward-forward motion Loses liquid
12	Uses a sucking pattern when drinking from the cup Extension-retraction motions of the tongue are not observed during drinking or as cup is inserted or removed Jaw movement may be in a wide up-down or backward-forward direction Tongue may protrude beneath cup May lose liquid
18	a) Uses a sucking pattern when drinking from cup External jaw stabilization is obtained by biting down on edge of cup Upper lip is closed on edge of cup Tongue does not protruded from mouth or rest beneath up May lose liquid; OR b) Minimal up-down or backward-forward movement occurs as child moves gradually from an unstabilized jaw movement toward internal jaw stabilization
24	Uses a sucking pattern with cup placed between lips Internal jaw stabilization is obtained through co-activation of the jaw opening and closing muscles. This internal stabilization occurs less than 75% of the time during drinking sequences of 2 or more sucks. This pattern may alternate with slight up-down motion or biting on cup May lose liquid
+24	Uses a sucking pattern and active internal jaw stabilization without biting on cup Internal stabilization occurs more than 75% of the time during drinking sequences of 2 or more sucks. This pattern may alternate with slight up-down motion or biting on cup. May lose liquid.
Sucking: Pureed foods from the spoon	
3	Suckling or sucking pattern is observed in the tongue and/or jaw as food approaches mouth or touches lips Upper lip does not assist in removal of food from spoon
6	The child shows visual or tactile recognition of the spoon The tongue and jaw remain quiet until the food enters the mouth The upper lip is slightly forward or downward but does not show a downward and forward movement which actively cleans the spoon
8	The upper lip moves downward and forward to posture or rest on the spoon and assists in removing food from the spoon

10	The lower lip draws inward as the spoon is removed or as food remains on the lower lip Specific cleaning movements are not observed The upper lip actively removes the food from the spoon.
15	The upper incisors are used to clean the lower lip as it draws inward The tongue shows sucking or a mixture of sucking and suckling A phasic bite reflex is not present at any time; however, some playful biting on the spoon in a game-like fashion may continue to occur
+24	The tongue is used in a free sweeping movement to clean food from the upper and lower lips Tongue elevation and depression are independent of jaw movement and show some skillful action of the tongue tip Slight lateral movements of the jaw may be observed Suckling movements of the tongue may occur intermittently.

SWALLOWING

Swallowing: Liquids

1	Swallows thin liquids from the bottle or breast The tongue may protrude with an extension-retraction movement pattern during the swallow or it may simply protrude between the teeth
6	Swallows liquids from the cup with no observable elevated tongue-tip position The tongue protrudes with an extension-retraction movement pattern during the swallow or shows simple protrusion between the teeth The lips may be open during the swallow There may be some loss of liquid
12	Swallows liquids from the cup with an intermittent elevated tongue-tip position. This pattern may alternate with either an extention-retraction pattern or simple protrusion of the tongue between the teeth. The lips may be open during the swallow There may be loss of liquid
24	Swallows from the cup with easy lip closure and no loss of liquid both during drinking and after the cup is removed from the mouth An elevated tongue position is used intermittently or consistently for swallowing
+24	Swallows with no observable extension-retraction or protrusive movements of the tongue Uses easy lip closure as needed and no liquid loss during drinking or after the cup is removed from the mouth

Swallowing: Semi-solids

3	Swallows soft or pureed foods (semi-solids) Gagging, choking, coughing, vomiting or spitting occur less than 25% of the time Child uses a primitive suckle-swallow response to move food into pharynx for swallowing Some food is pushed out of the mouth
6	Gagging, choking, coughing, vomiting or spitting occur less than 3 times during meal Tongue shows an extension-retraction pattern or simple protrusion between teeth during the swallow Food is not pushed out of the mouth by the tongue although minor losses of food and saliva occur
9	Child does not depend upon a suckle-swallow response to move food into pharynx for swallowing Some swallows follow the up-down tongue movement of true suck Tongue shows a simple protrusion between teeth or gums

	Some extension-retraction movements of tongue may continue intermittently
12	Swallows semi-solid foods with intermittent elevated tongue-tip position. This pattern may alternate with tongue protrusion.
	Swallows with easy lip closure as needed and no loss of food or saliva
18	Elevated tongue position used intermittently or consistently for swallowing
	Some simple protrusion of the tongue may be observed during swallowing
	No extension-retraction movements of the tongue are present
+24	Swallows with no loss of food or saliva
	An elevated tongue is used for swallowing
	No tongue protrusion is observed

Swallowing: Solids

6	Swallows some ground, mashed or chopped table foods with noticeable lumps
	Gags, chokes, spits, or vomits less than 25% of the time from food of this type contacting or resting on the posterior half of the tongue
	May use a simple protrusion of the tongue between the teeth or extenstion-retraction movements
12	Swallows ground, mashed or chopped table foods with noticeable lumps
	Gagging, choking, vomiting or spitting occur less than 3 times per meal
	Uses an intermittently elevated tongue-tip position. This pattern may alternate with a simple protrusion of the tongue between the teeth.
	No extension-retraction movements are present during swallowing
	There may be loss of food or saliva
18	Swallows solid foods with easy lip closure as needed and no loss of food or saliva
	An elevated tongue position is used for swallowing
	Some protrusive movements of the tongue are observed during swallowing
+24	Swallows solid foods with easy lip closure as needed and no loss of food or saliva
	An elevated tongue position is used for swallowing
	No tongue protrusion is observed during swallowing

Coordination of sucking, swallowing and breathing

1	Child sequences 2 or more sucks from the bottle or breast before pausing to breathe or swallow
	Breathing may become nosier during feeding
3	Long sequences of twenty or more sucks are present with bottle
	Swallowing follows sucking with no discernable pauses when child is hungry and not looking around
	Sucking motions occur almost simultaneously with swallowing (i.e., with overlapping motions)
	Pauses for breathing are infrequent
	There may be occasional coughing or choking indicating poor timing of the suck-swallow pattern with breathing
6	Long sequences of sucking-swallowing-breathing are observed with the bottle
	The child takes liquids from cup
	During cup drinking many continuous sucks are observed which are not followed by coordinated swallowing
	Much liquid is lost
	Intake of larger mouthfuls of liquid may result in coughing and choking
9	Long sequences of continuous sucks which are not timed with swallowing may continue to occur
	During cup drinking the child takes only one to three sucks before stopping or pulling away to swallow or breathe
	Coughing, choking or sputtering may occur
12	Swallowing follows sucking with no pause as the child drinks from the cup
	Some coughing and choking may continue to occur
	Sequences of at least 2 suck-swallows occur when the child is thirsty

	Intake during each suck-swallow is less than 1 ounce
15	Swallowing follows sucking with no pause as the child drinks from the cup The pattern is well-coordinated with respiration and coughing and choking are rarely observed The child is able to sequence at least 3 suck-swallows while drinking one ounce or more of liquid from the cup without major pauses The child may continue to use a shorter suck-swallow sequence when not thirsty or interested in drinking

BITING AND CHEWING

Jaw movement in biting

5	Primitive phasic bite and release pattern Lack of sustained bite
9	Holds cookie between gums/teeth without biting through Maintains quiet jaw as feeder breaks off piece of cookie
12	Controlled, sustained bite on soft cookie; unsustained for hard cookie
18	Controlled sustained bite on hard cookie with overflow or associated movements in arms and legs or head extension to assist in biting
21	Controlled sustained bite on hard cookies without overflow or associated movements Full open mouth position used in preparation for biting food of different thicknesses
24	Sustained controlled bite with head in midline Graded opening of jaw appropriate for different thicknesses

Jaw movement in chewing

5	Primitive phasic bite and release pattern, regular stereotyped rhythm
6	Primarily non-stereotyped vertical movement Diagonal-rotary or phasic bite and release movements may occur
9	Primarily non-stereotyped vertical movement Diagonal-rotary jaw movements with food transfer to side of mouth
15	Mixture of unstereotyped vertical and diagonal-rotary movements Rotary jaw movements are smooth and well-coordinated
+24	Primarily non-stereotyped vertical movement Some diagonal-rotary jaw movements may occur Circular-rotary jaw movements occur with transfer of food across midline

Lip movement during spoon feeding

3	Upper lip does not assist in removal of food from spoon
6	Upper lip slightly forward or downward but does not show a downward or forward movement to actively clean the spoon
8	Upper lip moves downward and forward to posture or rest on the spoon and assist in removing food from the spoon
10	Lower lip draws inward as spoon is removed from mouth or as food remains on lower lip Upper lip actively removes food from spoon
15	Upper incisors used to clean lower lip as its drawn inward

Lip movement in chewing

6	Slight drawing in of either the upper or lower lip or a tightening of the corner of the mouth when food is on the lips
9	Lips are active with the jaw and make some mechanical contact at the sides or in the center as the jaw moves up and down Upper lip comes forward and down in an active manner during chewing Upper or lower lips draw in when food is on the lips
12	Lips are active in chewing

15	Upper and lower lips are active in chewing and cleaning Corner of the lip and cheek draws inward and assists in controlling placement or movement of food in the mouth
18	Capable of chewing with his lips closed and does so intermittently
24	Adequate lip movement during chewing and does not lose any food or saliva from the mouth while chewing Capable of chewing with his lips closed although he may not do so consistently
Tongue movements during spoon feeding	
3	Suckling or sucking pattern as food approaches mouth
6	Tongue remains quiet until food enters the mouth
15	Tongue shows sucking or a mixture of sucking and suckling
+24	Tongue is used in a free sweeping movement to clean food from the upper and lower lips Tongue elevation and depression are independent of jaw movement and show some skillful action of the tongue tip Suckling movements of the tongue may occur intermittently
Tongue movements in chewing	
6	Tongue shows predominately a munching pattern and no lateralization of the tongue with solid foods
7	Tongue begins to show some lateralization with a gross rolling movement or simple horizontal shift when food is placed between the biting surfaces in the molar area Tongue is able to move to the side in this manner but may revert to a suckling pattern when food is placed in the center of the tongue or needs to be transferred from side to side
9	Lateral movements of the tongue continue when food is placed on the sides Intermittent extension-retraction movements may continue
12	Able to transfer it to both sides with tongue movements when food is placed in the center of the tongue Intermittent extension-retraction movements may continue
24	Transfer of food across midline occurs when food is placed on both sides of the mouth when food is placed between the biting surfaces Midline transfers are spontaneous and automatic
+24	Food can be transferred from center-to-side and from side-to-side across midline with equal skill rapidly Extension-retraction movements do not occur

Appendix C: Oral-motor skills and operational definitions for each texture category adapted from the Schedule for Oral Motor Assessment (SOMA**)** (Reilly et al., 2000)

Texture category: puree

Head orientation to food
The infant moves his/her head, body or trunk towards the spoon or drink. This movement may involve trunk or head extension or a variety of other movements. The movement should be carefully checked in slow motion on the video if it is not obvious. In children with neuromotor impairments the movement is often subtle.
Score 'yes' if present. This is normal response.

Smooth sequence
A smooth sequence of at least three or more suck swallows, munching actions or chewing actions are seen. There are no co-ordination difficulties with integrating suck swallow or chew/munch swallow.
Score 'yes' if present. This is a normal response.

Lower lip draws inward around spoon
Susan Evans-Morris, a clinician and researcher, describes the ability of the lower lip to draw inwards around the spoon as part of the process of separation of movement and the development of skill and precision. That is, the lips no longer move in unison with the jaw or tongue and the lower lip can mould around the spoon independently and draw inwards to help keep in the mouth when the spoon is withdrawn.
Score 'yes' if present. This is a normal response.

Upper lip actively removes food from the spoon
The upper lip is able to move forwards and downwards to help clean the spoon of food or remove food from the spoon. The lips may mould completely around the spoon or the mid-point of the upper lip only may make contact.
Score 'yes' if present. This is a normal response.

Lower/upper lip assists in cleaning
The lower and upper lips assist in cleaning food from the lips. For example, the lower lip is moved against the upper teeth or gums or upper lip in order to clean and retrieve small pieces of food.
Score 'yes' if present. This is a normal response.

Lower lip active during sucking/chewing/munching
The lower lip is active during the sucking, munching or chewing sequence. Early in development this movement is not separated from the total movement patterns of the jaw and tongue. However, this separation takes place and the upper and lower lips can function independently. This movement may be used to help in the cleaning process, such as moving down to clean with the lower lip or it may assist in keeping food within the mouth and preventing spillage.
Score 'yes' if present. This is a normal response.

Consistent/considerable tongue protrusion
The tongue protrudes consistently throughout the sucking/munching or chewing sequence (more than 50% of the time) representing a more infantile pattern of extension/retraction. The tongue may protrude to different degrees, either beyond the lower dentition or beyond the lower lip.
Score 'yes' if present. This is an abnormal response.

Tongue protrusion beyond the incisors
The tongue protrudes between the incisors but not beyond the lower lip.
Score 'yes' if present. This is an abnormal response.

Graded jaw opening to accept spoon
The jaw is opened sufficiently to accept a loaded spoon. There is neither too wide nor too narrow an excursion. In young babies and in children with cerebral palsy, often the opening is exaggerated or the jaw excursion may be too narrow to allow placement of the spoon.

Score ‘yes’ if present. This is a normal response.

Texture category: semi-solids

Consistent/considerable drooling
Drooling occurs more than 25% of the time during the sequence and this may or may not result in loss of food and/or liquid
Score ‘yes’ if present. This is an abnormal response.

Smooth sequence
A smooth sequence of at least three or more suck swallows, munching actions or chewing actions are seen. There are no co-ordination difficulties with integrating suck swallow or chew/munch swallow.
Score ‘yes’ if present. This is a normal response.

Sequence is initiated within 2 seconds
This refers to the time taken for the sequence to be initiated within the oral cavity. Timing begins when food/liquid is placed in the child’s mouth and the spoon is withdrawn. The therapist watches for movement indicating that the child has begun to suck, chew or munch. In most children without oral motor dysfunction this occurs almost immediately. However, in those with problems the sequence is often delayed and may be accompanied by panic reaction, etc.
Score ‘yes’ if sequence is initiated within 2 seconds. This is a normal response.

Lips closed during swallow
The child’s lips are firmly approximated when the swallow takes place. Scoring this item is dependent on being able to predict when a swallow occurs.
Score ‘yes’ if present. This is a normal response.

Graded jaw opening to accept spoon
The jaw is opened sufficiently to accept a loaded spoon. There is neither too wide nor too narrow an excursion. In young babies and in children with cerebral palsy, often the opening is exaggerated or the jaw excursion may be too narrow to allow placement of the spoon.
Score ‘yes’ if present. This is a normal response.

Internal jaw stabilization
External stabilization is not required. The child can separate lip and tongue movements from the mandible, which now moves independently and there is no longer any need to bite down on the spoon to stabilize the jaw. There is little liquid loss during drinking or food loss during eating, as the lips and tongue now exhibit a more mature degree of control. There are much reduced vertical mandibular movements.
Score ‘yes’ is jaw stabilization is present. This is a normal response.

Associated jaw movements
Associated and sometimes exaggerated jaw movements are used to move food within the oral cavity. Sometimes these may appear ‘dystonic-like’. They are compensatory movements used when a full range of tongue movements are unavailable.
Score ‘yes’ if present. This is an abnormal response.

Texture category: solids

Food loss none/trivial
Once the food has been place in the child’s mouth there is minimal drooling or food loss, that is, less than 25% of the total inserted.
Score ‘yes’ if present. This is a normal response.

Consistent/considerable drooling

Drooling occurs more than 25% of the time during the sequence and this may or may not result in loss of food and/or liquid

Score 'yes' if present. This is an abnormal response.

Smooth sequence

A smooth sequence of at least three or more suck swallows, munching actions or chewing actions are seen. There are no co-ordination difficulties with integrating suck swallow or chew/munch swallow.

Score 'yes' if present. This is a normal response.

Lower lip draws inward around spoon

Susan Evans-Morris, a clinician and researcher, describes the ability of the lower lip to draw inwards around the spoon as part of the process of separation of movement and the development of skill and precision. That is, the lips no longer move in unison with the jaw or tongue and the lower lip can mould around the spoon independently and draw inwards to help keep in the mouth when the spoon is withdrawn.

Score 'yes' if present. This is a normal response.

Upper lip actively removes food from the spoon

The upper lip is able to move forwards and downwards to help clean the spoon of food or remove food from the spoon. The lips may mould completely around the spoon or the mid-point of the upper lip only may make contact.

Score 'yes' if present. This is a normal response.

Lower lip positioned behind upper incisors/gums as part of total sucking pattern

The child's sucking pattern includes drawing in the lower lip in a retracted position as the child sucks. Evans-Morris would describe this as lack of separation of movement. The lips do not function independently as there is no separation of movement from the tongue, lips and jaw. Instead they move in one sequence.

Score 'yes' if present. This is an abnormal response.

Lower lip active during sucking/chewing/munching

The lower lip is active during the sucking, munching or chewing sequence. Early in development this movement is not separated from the total movement patterns of the jaw and tongue. However, this separation takes place and the upper and lower lips can function independently. This movement may be used to help in the cleaning process, such as moving down to clean with the lower lip or it may assist in keeping food within the mouth and preventing spillage.

Score 'yes' if present. This is a normal response.

Transient/minimal tongue protrusion

The tongue protrudes occasionally when swallows occur or to clean the lips, but protrusion is minimal and does not interfere with range of tongue movements or ability to manage food/liquid.

Score 'yes' if present. This is a normal response.

Graded jaw opening to accept spoon

The jaw is opened sufficiently to accept a loaded spoon. There is neither too wide nor too narrow an excursion. In young babies and in children with cerebral palsy, often the opening is exaggerated or the jaw excursion may be too narrow to allow placement of the spoon.

Score 'yes' if present. This is a normal response.

<u>Texture category: cracker</u>

Profuse/marked food loss

Once the food has been place in the child's mouth the amount of food lost/drooled is more than 25% of the total inserted.

Score 'yes' if present. This is an abnormal response.

Consistent/considerable drooling

Drooling occurs more than 25% of the time during the sequence and this may or may not result in loss of food and/or liquid

Score 'yes' if present. This is an abnormal response.

Sequence is initiated within 2 seconds
This refers to the time taken for the sequence to be initiated within the oral cavity. Timing begins when food/liquid is placed in the child's mouth and the spoon is withdrawn. The therapist watches for movement indicating that the child has begun to suck, chew or munch. In most children without oral motor dysfunction this occurs almost immediately. However, in those with problems the sequence is often delayed and may be accompanied by panic reaction, etc.

Score 'yes' if sequence is initiated within 2 seconds. This is a normal response.

Lower lip positioned behind upper incisors/gums as part of total sucking pattern
The child's sucking pattern includes drawing in the lower lip in a retracted position as the child sucks. Evans-Morris would describe this as lack of separation of movement. The lips do not function independently as there is no separation of movement from the tongue, lips and jaw. Instead they move in one sequence.

Score 'yes' if present. This is an abnormal response.

Lips close around stimulus during biting
Both the upper and lower lips close and mould firmly around the cracker during biting.

Score 'yes' if present. This is a normal response.

Lips are closed intermittently during munching/chewing and sucking
The lips are closed for part of the sequence of chewing and munching (about 50% of the time). During sucking the lips tend to be closed, but when munching and chewing it is acceptable for them to be open or partially open for some time depending on the bolus being manipulated.

Score 'yes' if present. This is a normal response.

Transient/minimal tongue protrusion
The tongue protrudes occasionally when swallows occur or to clean the lips, but protrusion is minimal and does not interfere with range of tongue movements or ability to manage food/liquid.

Score 'yes' if present. This is a normal response.

Consistent/considerable protrusion
The tongue protrudes consistently throughout the sucking/munching or chewing sequence (more than 50% of the time) representing a more infantile pattern of extension/retraction. The tongue may protrude to different degrees, either beyond the lower dentition or beyond the lower lip.

Score 'yes' if present. This is an abnormal response.

Tongue protrusion beyond the incisors
The tongue protrudes between the incisors but not beyond the lower lip.

Score 'yes' if present. This is an normal response.

Tongue protrudes beyond the lower lip
The tongue protrudes more extensively, well beyond the lower lip. It may protrude under the cup or into the cup or under the biscuit during biting.

Score 'yes' if present. This is an abnormal response.

Internal jaw stabilization
External stabilization is not required. The child can separate lip and tongue movements from the mandible, which now moves independently and there is no longer any need to bite down on the spoon to stabilize the jaw. There is little liquid loss during drinking or food loss during eating, as the lips and tongue now exhibit a more mature degree of control. There are much reduced vertical mandibular movements.

Score 'yes' is jaw stabilization is present. This is a normal response.

Variable stabilization required
Jaw stabilization is not yet fully established and may exist for only part of the time, e.g. 50%.

Score 'yes' if present. This is an abnormal response.

External stabilization required and considerable
The child cannot stabilize the jaw and needs to bite on the spoon or cup to provide this stability. The jaw excursions are often wide and the lips and tongue move in unison with the mandible. Liquid and food loss may be considerable.

Score 'yes' if present. This is an abnormal response.

Vertical movements
Vertical movements of the jaw are seen to break the biscuit during the bite and to munch and chew.

Score 'yes' if present. This is a normal response.

Wide vertical movements
Excursions of the jaw are wide and not measured. This may occur during both biting and munching/chewing, indicating a lack of stabilization or poorly controlled movements.

Score 'yes' if present. This is an abnormal response.

Small vertical excursions
Small, measured vertical excursions are the nor and these movements are generally well controlled and present, unless a huge bolus is being manipulated.

Score 'yes' if present. This is a normal response.

Associated head/extension/movements
These may be seen when biting any sort of biscuit. There is increased head extension or increased body and nck tension. May indicate a lack of strength or inadequate jaw stabilization. (May be facial grimaces or increase in tension in the facial muscles.)

Score 'yes' if present. This is an abnormal response.

Gagging
Any gagging/heaving responses seen in response to food presentation. These may occur at the sight of food or the spoon, when food enters the mouth or when food is moved back on the tongue in preparation for swallowing.

Score 'yes' if present. This is an abnormal response.

Controlled sustained bite
Functional well-controlled bite on variations in materials, that is hard or soft biscuits. The strength of the bite is adequate to break pieces off. Strength is adjusted to suit the hardness of the biscuit.

Score 'yes' if present. This is a normal response.

Graded jaw opening to accept variable thicknesses
The child is able to grade different sized openings of the jaw to accept a variety of thicknesses of biscuit, etc. The jaw opening is neither too wide nor too narrow.

Score 'yes' if present. This is a normal response.

Mouths on biscuit/cracker only
The child makes no attempt to bite or suck on the biscuit, the only actions being of the mouthing kind. For example, the child may lick the biscuit or touch it with his/her lips, etc.

Score 'yes' if present. This is an abnormal response

Appendix D: 175 oral-motor skills including function, judge agreement on scorability, source and phase of feeding process

	Oral-motor skill	Functional code	Judge agreement (Total=10)	Source	Phase
	Spoon				
1	Anticipation of food shown by keeping tongue and jaw quiet when spoon is 5 cm from lips	awareness	6	3	1
2	Brings head forward to spoon	awareness	10	2	1
3	Turns head to spoon	awareness	10	6	1
4	Fixes gaze on spoon	awareness	10	6	1
5	Leans towards spoon	awareness	10	2	1
6	Head orientation to spoon	awareness	6	4	1
7	Reaches for spoon	awareness	10	6	1
8	Opening mouth in anticipation	other	10	5	1
9	Anticipation of food shown as tongue initiates suckling when seeing spoon approach mouth	other	6	3	1
10	Jaw closes on spoon	jaw closure	7	6	1
11	Internal jaw stabilization	jaw closure	0	4	1
12	Jaw/mouth remains open while spoon enters mouth	jaw opening	10	6	1
13	Mouth opens wide enough for spoon	jaw opening	10	6	1
14	Holds jaw stable	jaw opening	2	2	1
15	Quieting or inhibition of jaw and tongue movement as child anticipates entrance of the spoon	jaw opening	3	1	1
16	Graded jaw opening to accept spoon	jaw opening	2	4	1
17	Graded jaw opening	jaw opening	2	4	1
18	Jaw open at midrange	jaw opening	4	5	1
19	Jaw opens symmetrically	jaw opening	8	5	1
20	Food removal: no effort made	lip closure-object	6	3	1
21	Food removal as sucks, bites on spoon	lip closure-object	8	3	1
22	Lower lip makes contact with bottom of spoon	lip closure-object	10	6	1
23	Spoon is cleared	lip closure-object	10	6	1
24	Spoon is easily removed from mouth	lip closure-object	10	6	1
25	Upper lip contacts spoon	lip closure-object	10	6	1
26	Lower lips draws inward under spoon	lip closure-object	7	6	1
27	Brings upper lip down and forward on spoon	lip closure-object	7	2	1

	Oral-motor skill	Functional code	Judge agreement	Source	Phase
28	Pulls lower lip inwards under spoon	lip closure-object	6	2	1
29	Upper lip comes forward and down to assist in cleaning food from Spoon	lip closure-object	7	1	1
30	Lower lip draws inward after spoon removal	lip closure-object	8	1	1
31	Lower lip draws inward around spoon	lip closure-object	5	4	1
32	Upper lip removes food from spoon	lip closure-object	7	4	1
33	Bottom lip forms seal on spoon	lip closure-object	6	5	1
34	Active use of upper lip to clear bowl of spoon	lip closure-object	7	5	1
35	Food removal by full lip occlusion	lip closure-object	8	3	1
36	Anticipation of food shown as tongue initiates suckling when spoon touches tongue or lips	tongue movement	7	3	1
37	Extension-retraction suckle pattern of tongue with the spoon	tongue movement	3	1	1
38	Anticipation of food shown by tongue protruding when spoon is 5 cm from lips	tongue movement	6	3	1
39	Up-down suck pattern of tongue with the spoon	tongue movement	4	1	1
40	Tongue remains on floor of mouth when spoon presented	tongue-position	7	6	1
41	Tongue remains in mouth	tongue-position	10	6	1
42	Keeps tongue still on floor of mouth	tongue-position	4	2	1
43	Sequence initiated within 2 seconds	coordination	3	4	2
44	Smooth rhythmic sequence	coordination	4	4	2
45	Jaw movements observed	jaw movement	8	6	2
46	Lower lip active during suck/chew/munch	lip closure-manipulation	6	4	2
47	Lips closed while eating	lip closure-manipulation	9	5	2
48	Food observed outside of mouth	maintenance	10	6	2
49	No food loss	maintenance	10	5	2
50	Reaction to food after removal from spoon: food loss, no food retrieval	other	9	3	2
51	Teeth used to retrieve food left outside of mouth	retrieval	10	6	2
52	Wipes spillage without prompting	retrieval	9	5	2
53	Tongue used to retrieve food left outside of mouth	retrieval	9	6	2
54	Lips used to retrieve food left outside of mouth	retrieval	9	6	2
55	Lower/upper lip assists in cleaning	retrieval	7	4	2
56	Clears excess food off lips with tongue	retrieval	9	2	2
57	Cleans lips with tongue with up-down and sweeping motions	retrieval	6	1	2

	Oral-motor skill	Functional code	Judge agreement	Source	Phase
58	Tongue movement when food is in mouth: tongue and jaw in rhythmic pattern	tongue movement	3	3	2
59	Tongue forms adequate bolus	tongue movement	3	5	2
60	Tongue movement when food is in mouth: mouth closed	tongue movement	3	3	2
61	Tongue movement when food is in mouth: tongue in midline	tongue position	4	3	2
62	Keeps lips closed during swallowing	lip closure-swallow	10	2	3
63	Purse lips to initiate swallowing	lip closure-swallow	6	3	3
64	Draws in lower lip to initiate swallowing	lip closure-swallow	4	3	3
65	Press lips together to initiate swallowing	lip closure-swallow	6	3	3
66	Lips closed during swallow	lip closure-swallow	10	4	3
67	Food or saliva loss in sucking and swallowing	maintenance	10	1	3
68	Tongue retracts when swallowing	tongue movement	4	5	3
69	Tongue protrudes when swallowing	tongue movement	9	5	3
70	Suckle-swallow protrusion of tongue	tongue movement	1	1	3
71	Simple tongue protrusion	tongue movement	5	1	3
72	Tongue on top of teeth to initiate swallowing	tongue position	2	3	3
73	Tongue on lower lip to initiate swallowing	tongue position	4	3	3
74	Elevated tongue with jaw separation	tongue position	4	1	3
	Solids				
75	Head extension or other associated movement	awareness	6	1	1
76	Holds head steady slightly forward in midline	awareness	9	2	1
77	Associated head movements	awareness	3	4	1
78	Uses sucking or suckling only for biting	biting	5	1	1
79	Uses a phasic bite-release with no or minimal bite through	biting	3	1	1
80	Controlled bite	biting	5	1	1
81	Controlled sustained bite	biting	7	4	1
82	Mouths cracker only	biting	8	4	1
83	Bites completely through food	biting	10	5	1
84	Bites centrally	biting	7	5	1
85	Bites on right side of mouth	biting	10	5	1
86	Bites of left side of mouth	biting	10	5	1
87	Gums/teeth contact food	biting	10	6	1
88	Jaw closes and breaks through food in single motion	biting	8	6	1
89	Brings upper and lower molars together	biting	5	2	1
90	Symmetrical jaw movement	jaw movement	8	5	1
91	Graded jaw opening	jaw opening	2	4	1
92	Jaw open at midrange	jaw opening	6	5	1

	Oral-motor skill	Functional code	Judge agreement	Source	Phase
93	Graded jaw movement	jaw opening	2	5	1
94	Lips close around stimulus during biting	lip closure-object	8	4	1
95	Lips close on food	lip closure-object	9	6	1
96	Keeps tongue still on floor of mouth	tongue position	4	2	1
97	Stereotyped phasic bite and release pattern in chewing	biting	0	1	2
98	Cheeks are used actively to control or move the food	cheek activity	3	1	2
99	Non-stereotyped variable vertical chewing pattern of the jaw	chewing	0	1	2
100	Diagonal-rotary pattern of the jaw to the side of food placement	chewing	0	1	2
101	Circular-rotary pattern of the jaw in transferring food across midline	chewing	0	1	2
102	Munching	chewing	4	1	2
103	Reaction to food after removal from spoon: initiates movement of food	chewing	6	3	2
104	Reaction to food after removal from spoon: initiates chewing	chewing	10	3	2
105	No chewing. Sucking or suckling only with food	chewing	6	1	2
106	Sequence initiated within 2 seconds	coordination	3	4	2
107	Internal jaw stabilization established	jaw closure	0	4	2
108	Vertical movements	jaw movement	8	4	2
109	Wide vertical excursions	jaw movement	5	4	2
110	Small vertical excursions	jaw movement	5	4	2
111	Immediate jaw excursion	jaw movement	3	6	2
112	Lips are active with the jaw and make some mechanical contact during chewing	lip closure-manipulation	5	1	2
113	Upper lip moves actively forward and down during chewing	lip closure-manipulation	7	1	2
114	Upper and lower lip is drawn actively inward during chewing	lip closure-manipulation	6	1	2
115	Chews with lips closed	lip closure-manipulation	10	1	2
116	Lower lip positioned behind teeth to suck	lip closure-manipulation	7	4	2
117	Lips are closed intermittently during munch/chew	lip closure-manipulation	9	4	2
118	If lips are observed open, food remains in the mouth	maintenance	10	6	2
119	Does not lose food or saliva during chewing	maintenance	10	1	2
120	Tongue tip separates from jaw and elevates to clean the lips or buccal cavity	retrieval	5	1	2
121	Upper incisors are used to clean or retrieve food from the lower lip during chewing	retrieval	9	1	2
122	Cleaning movements are smoothly integrated with chewing	retrieval	3	1	2
123	Hands, teeth, lips, tongue clear food from lips	retrieval	8	6	2
124	Lateral transfer of bolus with tongue	jaw movement	8	6	2
125	Extension-retraction movements of the tongue mixed with chewing	tongue movement	3	1	2
126	Tongue movement when food is in mouth: lateralizing	tongue movement	4	3	2

	Oral-motor skill	Functional code	Judge agreement	Source	Phase
127	Tongue lateralization with food placement on the side	tongue movement	6	1	2
128	Tongue lateralization and transfer of food from the center to both sides	tongue movement	6	1	2
129	Tongue lateralization transferring food from one side to the other across midline	tongue movement	7	1	2
130	Tongue separates from jaw and moves the food laterally while the jaw remains in midline	tongue movement	5	1	2
131	Moves food from side to side with tongue (rotary jaw movement)	tongue movement	6	2	2
132	Uses fingers to transfer food	tongue movement	7	4	2
133	Forms adequate bolus	tongue movement	3	2	2
134	Tongue protrudes beyond lips	other	10	4	2
135	Keeps tongue still on floor of mouth	tongue position	6	4	2
136	Lip closure in swallowing solids	lip closure-swallow	10	1	3
137	Keeps lips closed while swallowing solids	lip closure-swallow	10	2	3
138	Food remains in mouth as food is pushed backwards	maintenance	9	6	3
139	Simple tongue protrusion with solids	tongue movement	4	1	3
140	Transports solids to back of mouth	tongue movementt	4	2	3
141	Tongue remains in mouth as food is pushed backwards	tongue position	9	6	3
142	Elevated tongue with jaw separation for solids	tongue position	4	1	3
	Liquids				
143	Bites on cup or straw for stability	jaw closure	6	5	1
144	Jaw alignment during drinking	jaw closure	3	4	1
145	Internal stabilization	jaw closure	0	4	1
146	Jaw alignment	jaw closure	1	4	1
147	Keeps jaw and lower lip stable	other	6	2	1
148	Forms lip seal on cup	lip closure-object	10	2	1
149	Moves upper lip to draw in liquid	lip closure-object	6	2	1
150	Adequate lip seal on cup	lip closure-object	8	5	1
151	Lips close around straw	lip closure-object	10	5	1
152	Keeps tongue within oral cavity	tongue position	10	2	1
153	Tongue under cup	tongue position	8	5	1
154	Small vertical movements	jaw movement	4	4	2
155	Loss of fluid from mouth with cup	maintenance	9	5	2
156	Suckle-swallow	tongue movement	3	5	2
157	Suck-swallow	tongue movement	4	5	2
158	Suckle-swallow protrusion of tongue with liquids	tongue movement	3	1	2
159	Simple tongue protrusion with liquids	tongue movement	6	1	2
160	Elevated tongue with jaw separation for liquids	tongue movement	3	1	2

	Oral-motor skill	Functional code	Judge agreement	Source	Phase
161	Consecutive swallows with cup	# of sips/swallows	9	5	3
162	Single-sips-swallows with cup	# of sips/swallows	9	5	3
163	Consecutive swallows with straw	# of sips/swallows	7	5	3
164	Single-sips-swallows with straw	# of sips/swallows	10	5	3
165	Continuous sucks from the cup; poorly coordinated with swallowing	# of sips/swallows	3	1	3
166	Takes 1-3 sucks from the cup and stops or pulls back	# of sips/swallows	5	1	3
167	Suck-swallow sequences greater than 3 sucks with intake of 1 oz. or more of liquid	# of sips/swallows	3	1	3
168	Effortless swallowing	coordination	4	5	3
169	Suck-swallow transition poorly coordinated with breathing: i.e., coughing and choking with cup	coordination	5	1	3
170	Keeps lips closed while swallowing liquids	lip closure-swallow	10	2	3
171	Lip closure in swallowing liquids	lip closure-swallow	10	1	3
172	Transports liquids to back of mouth	tongue movement	5	2	3
173	Tongue retracts during swallowing	tongue movement	4	5	3
174	Tongue protrudes during swallowing	tongue movement	7	5	3
175	Liquid loss during sucking and swallowing of liquids from a cup	maintenance	9	1	3

Functional code: Function of important structures involved in the feeding process

Judge agreement: Number of judges that agreed the oral-motor skill was scorable during a clinical feeding observation (Total=10)

Source: 1. Morris (1982) (PSAS); 2. Kenny et al. (1989); 3. Stolovitz & Gisel (1991); 4. Reilly et al. (1995) (SOMA); 5. Kumin & Bahr (1999); 6. Expert opinion;

Phase: 1. Acceptance; 2. Manipulation; 3. Transfer/Swallow

Appendix E: 67 oral-motor skills rated by experts as observable including function, judge agreement on scorability, source and phase of feeding process

	Oral-motor skill	Functional code	Judge agreement (Total=10)	Source	Phase
	Spoon				
1	Brings head forward to spoon	awareness	10	2	1
2	Turns head to spoon	awareness	10	6	1
3	Fixes gaze on spoon	awareness	10	6	1
4	Leans towards spoon	awareness	10	2	1
5	Reaches for spoon	awareness	10	6	1
6	Opening mouth in anticipation	other	10	5	1
7	Jaw/mouth remains open while spoon enters mouth	jaw opening	10	6	1
8	Mouth opens wide enough for spoon	jaw opening	10	6	1
9	Jaw opens symmetrically	jaw opening	8	5	1
10	Food removal as sucks, bites on spoon	lip closure-object	8	3	1
11	Lower lip makes contact with bottom of spoon	lip closure-object	10	6	1
12	Spoon is cleared	lip closure-object	10	6	1
13	Spoon is easily removed from mouth	lip closure-object	10	6	1
14	Upper lip contacts spoon	lip closure-object	10	6	1
15	Lower lip draws inward after spoon removal	lip closure-object	8	1	1
16	Food removal by full lip occlusion	lip closure-object	8	3	1
17	Tongue remains in mouth	tongue-position	10	6	1
18	Jaw movements observed	jaw movement	8	6	2
19	Lips closed while eating	lip closure-manipulation	9	5	2
20	Food observed outside of mouth	maintenance	10	6	2
21	No food loss	maintenance	10	5	2
22	Reaction to food after removal from spoon: food loss, no food retrieval	other	9	3	2
23	Teeth used to retrieve food left outside of mouth	retrieval	10	6	2
24	Wipes spillage without prompting	retrieval	9	5	2
25	Tongue used to retrieve food left outside of mouth	retrieval	9	6	2
26	Lips used to retrieve food left outside of mouth	retrieval	9	6	2
27	Clears excess food off lips with tongue	retrieval	9	2	2
28	Keeps lips closed during swallowing	lip closure-swallow	10	2	3
29	Lips closed during swallow	lip closure-swallow	10	4	3
30	Food or saliva loss in sucking and swallowing	maintenance	10	1	3

	Oral-motor skill	Functional code	Judge agreement	Source	Phase
31	Tongue protrudes when swallowing	tongue movement	9	5	3
	Solids				
32	Holds head steady slightly forward in midline	awareness	9	2	1
33	Mouths cracker only	biting	8	4	1
34	Bites completely through food	biting	10	5	1
35	Bites on right side of mouth	biting	10	5	1
36	Bites of left side of mouth	biting	10	5	1
37	Gums/teeth contact food	biting	10	6	1
38	Jaw closes and breaks through food in single motion	biting	8	6	1
39	Symmetrical jaw movement	jaw movement	8	5	1
40	Lips close around stimulus during biting	lip closure-object	8	4	1
41	Lips close on food	lip closure-object	9	6	1
42	Reaction to food after removal from spoon: initiates chewing	chewing	10	3	2
43	Vertical movements	jaw movement	8	4	2
44	Chews with lips closed	lip closure-manipulation	10	1	2
45	Lips are closed intermittently during munch/chew	lip closure-manipulation	9	4	2
46	If lips are observed open, food remains in the mouth	maintenance	10	6	2
47	Does not lose food or saliva during chewing	maintenance	10	1	2
48	Upper incisors are used to clean or retrieve food from the lower lip during chewing	retrieval	9	1	2
49	Hands, teeth, lips, tongue clear food from lips	retrieval	8	6	2
50	Tongue protrudes beyond lips	other	10	4	2
51	Lip closure in swallowing solids	lip closure-swallow	10	1	3
52	Keeps lips closed while swallowing solids	lip closure-swallow	10	2	3
53	Food remains in mouth as food is pushed backwards	maintenance	9	6	3
54	Tongue remains in mouth as food is pushed backwards	tongue position	9	6	3
55	Lateral transfer of bolus with tongue	tongue movement	8	6	2
	Liquids				
56	Forms lip seal on cup	lip closure-object	10	2	1
57	Adequate lip seal on cup	lip closure-object	8	5	1
58	Lips close around straw	lip closure-object	10	5	1
59	Keeps tongue within oral cavity	tongue position	10	2	1
60	Tongue under cup	tongue position	8	5	1
61	Loss of fluid from mouth with cup	maintenance	9	5	2

	Oral-motor skill	Functional code	Judge agreement	Source	Phase
62	Liquid loss during sucking and swallowing of liquids from a cup	maintenance	9	1	3
63	Consecutive swallows with cup	# of sips/swallows	9	5	3
64	Single-sips-swallows with cup	# of sips/swallows	9	5	3
65	Single-sips-swallows with straw	# of sips/swallows	10	5	3
66	Keeps lips closed while swallowing liquids	lip closure-swallow	10	2	3
67	Lip closure in swallowing liquids	lip closure-swallow	10	1	3

Functional code: Function of important structures involved in the feeding process

Judge agreement: Number of judges that agreed the oral-motor skill was scorable during a clinical feeding observation (Total=10)

Source: 1. Morris (1982) (PSAS); 2. Kenny et al. (1989); 3. Stolovitz & Gisel (1991); 4. Reilly et al. (1995) (SOMA); 5. Kumin & Bahr (1999); 6. Expert opinion

Phase: 1. Acceptance; 2. Manipulation; 3. Transfer/Swallow

Appendix F: Processes to identify and simplify texture-specific terms by function for the 67 scorable oral-motor skills

Function (oral-motor skills)	Edited oral-motor skills
# of sips/swallows	
1. Consecutive swallows with cup	1. Consecutive swallows
2. Single-sips-swallows with cup	2. Single-sip-swallow
3. Single-sips-swallows with straw	Same as #2
Awareness	
4. Brings head forward to spoon	3. Brings head forward to solid or utensil
5. Turns head to spoon	4. Turns head to solid or utensil
6. Fixes gaze on spoon	5. Looks at solid or utensil
7. Leans towards spoon	6. Leans towards solid or utensil
8. Reaches for spoon	7. Reaches for solid or utensil
9. Holds head steady slightly forward in midline	8. Holds head steady slightly forward in midline to accept the solid or utensil
Biting	
10. Mouths cracker only	9. Attempts to bite instead of only tasting or licking.
11. Bites completely through food	10. Bites completely through solid in one motion
12. Bites on right side of mouth	11. Bites on right side of mouth
13. Bites on left side of mouth	12. Bites on left side of mouth
14. Gums/teeth contact food	13. Gums / teeth contact solid during biting
15. Jaw closes and breaks through food in single motion	Combined with #11
Chewing	
16. Reaction to food after removal of spoon: initiates chewing	14. Chewing initiated after bolus enters mouth
Jaw movement	
17. Jaw movements observed	15. Up and down jaw movement when bolus is in mouth
18. Symmetrical jaw movement	16. Jaw moves vertically in midline
19. Vertical movements	Combined with #18
Jaw opening	
20. Jaw/mouth remains open while spoon enters mouth	17. Mouth remains open for solid or utensil to enter mouth
21. Mouth opens wide enough for spoon	18. Mouth opens enough for solid or utensil to enter mouth
22. Jaw opens symmetrically	19. Jaw opens vertically in midline during acceptance
Lip closure-manipulation	
23. Lips closed while eating	20. Lips closed during entire bolus manipulation
24. Chews with lips closed	Same as #23
25. Lips are closed intermittently during bolus manipulation	21. Lips are closed intermittently during bolus manipulation
Lip closure-object	
26. Food removal as sucks, bites on spoon	22. Gums or teeth used to remove bolus
27. Lower lip makes contact with bottom of spoon	23. Lower lip touches bottom of solid or utensil
28. Spoon is cleared	24. Spoon is cleared
29. Spoon is easily removed from mouth	25. Solid or utensil is removed from mouth without resistance
30. Upper lip contacts spoon	26. Upper lip touches solid or utensil
31. Lower lip draws inward after spoon removal	27. Lower lip draws inward after removal of solid or utensil
32. Food removal by full lip occlusion	28. Bolus removed from utensil with both lips

33. Lips close around stimulus during biting	29. Lips touch solid during biting
34. Lips close on food	30. Lips touch solid or utensil
35. Forms lips seal on cup	Same as #34
36. Adequate lip seal on cup	Same as #34
37. Lips close around straw	Same as #34
Lip closure-swallow	
38. Keeps lips closed during swallowing	31. Keeps lips closed during swallowing
39. Lips closed during swallow	Same as #38
40. Lip closure in swallowing solids	Same as #38
41. Keeps lips closed while swallowing solids	Same as #38
42. Keeps lips closed while swallowing liquids	Same as #38
43. Lip closure in swallowing liquids	Same as #38
Maintenance	
44. Food observed outside of mouth	32. Bolus observed outside of mouth
45. No food loss	33. No bolus loss from mouth
46. Food or saliva loss in sucking and swallowing	Same as #50
47. If lips are observed open, food remains in mouth	Same as #45; lip position accounted for with #23 and #25
48. Does not lose food or saliva during chewing	34. No bolus loss during bolus manipulation
49. Food remains in mouth as food is pushed backwards	35. No bolus loss while pushing it backwards to swallow
50. Loss of fluid from mouth with cup	36. Loss of bolus from mouth
51. Loss with sucking and swallowing of fluids with cup	Same as #50
Retrieval	
52. Teeth used to retrieve food left outside of mouth	37. Teeth used to retrieve bolus outside of mouth
53. Wipes spillage without prompting	38. Hand used to wipe bolus outside of mouth
54. Tongue used to retrieve food left outside of mouth	39. Tongue used to retrieve bolus outside of mouth
55. Lips used to retrieve food left outside of mouth	40. Lips used to retrieve food left outside of mouth
56. Clears excess food off lips with tongue	Same of #55
57. Upper incisors are used to clean or retrieve food from the lower lip during chewing	41. Upper teeth used to retrieve bolus from lower lip during bolus manipulation
58. Hands, teeth, lips, tongue clear food from lips	Accounted for with #53, 54, 55, 56
Tongue movement	
59. Tongue protrudes when swallowing	42. Tongue protrudes beyond lips during swallowing
60. Lateral transfer of bolus with tongue	43. Bolus moved to right cheek with tongue 44. Bolus moved to left cheek with tongue
Tongue position	
61. Tongue remains in mouth as food is pushed backwards	45. Tongue remains in mouth as bolus is pushed backwards to swallow
62. Keeps tongue within oral cavity	Same as #64
63. Tongue under cup	46. Tongue protrudes under solid or utensil
64. Tongue remains in mouth	47. Tongue remains in mouth
Other	
65. Opening mouth in anticipation	48. Opens mouth when solid or utensil is brought to mouth
66. Reaction to food after removal from spoon: food loss, no food retrieval	49. Bolus loss during acceptance into mouth; retrieval accounted for with #53, 54, 55, 56
67. Tongue protrudes beyond lips	50. Tongue protrudes beyond lips

Appendix G: Final list of 56 scorable oral-motor skills organized into a texture by phase schema (highlighted cells do not apply to texture)
"1"=observed; "0"=not observed; "."=out of view; blocked by spoon; "9"=cannot score due to function of other skill (see scoring rules in Appendix H)

	Oral-motor skills Acceptance	Smooth puree (SP)			Textured puree (TP)			Solid (S)			Cracker Piece (CP)			Cracker whole (CW)		
	Trial	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Any food item offered from spoon, or fingers (cracker)	1. Brings head forward to solid or utensil															
	2. Turns head to solid or utensil															
	3. Looks at solid or utensil															
	4. Leans towards solid or utensil															
	5. Reaches for solid or utensil															
	6. Holds head steady slightly forward in midline to accept solid or utensil															
	7. Opens mouth when solid or utensil is brought to mouth															
	8. Jaw opens vertically in midline															
	9. Opens mouth before solid or utensil touches lips															
	10. Mouth opens enough for solid or utensil to enter mouth															
	11. Mouth remains open for solid or utensil to enter mouth															
	12. Tongue remains in mouth while solid or utensil enters															
	13. Upper lip touches solid or utensil															
	14. Lower lip touches bottom of solid or utensil															
	15. Lips touch solid or utensil															
	16. Gums or teeth are not used to remove bolus															
	17. Bolus removed from spoon with both lips															
	18. Solid or utensil is removed from mouth without resistance															
	19. Food not observed outside of mouth															
	20. Lower lip draws inward after removal of solid or utensil															
	21. Spoon is cleared															
	22. No bolus loss from mouth															
	23. OMITTED Bolus loss during acceptance into mouth															
Biting cracker	24. Lips touch solid during biting															
	25. Gums or teeth contact solid															
	26. Bites on right side of mouth behind incisors															
	27. Bites on left side of mouth behind incisors															
	28. Bites in front of mouth															
	29. Attempts to bite instead of only tasting or licking															
	30. Bites completely through solid in one motion															

	Oral-motor Skills Bolus Manipulation and Transfer and Swallow of Bolus	Smooth puree (SP)			Textured puree (TP)			Solid (S)			Cracker Piece (CP)			Cracker whole (CW)		
	Trial	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
All food textures	31. Bolus moved to right cheek with tongue															
	32. Bolus moved to left cheek with tongue															
	33. No assistance from fingers to move bolus in mouth															
	34. Chewing initiated after bolus enters mouth															
	35. Up and down jaw movement when bolus is in mouth															
	36. Jaw moves in various directions															
	37. No repetitive up/down tongue movement during bolus manipulation															
	38. Holds head steady slightly forward in midline during bolus manipulation															
	39. Lips closed during bolus manipulation															
	40. Lips are closed intermittently during bolus manipulation															
	41. No bolus loss during bolus manipulation															
	42. Tongue remains in mouth															
	43. OMITTED Tongue protrudes beyond lips															
	44. No repetitive forward/backward tongue movement during manipulation															
All food textures																
	45. Holds head steady slightly forward in midline during swallowing															
	46. Keeps lips closed during swallowing															
	47. No bolus loss while pushing it backwards to swallow															
	48. OMITTED Loss of bolus from mouth															
	49. Tongue remains in mouth as bolus is pushed backwards to swallow															
	50. OMITTED Tongue protrudes beyond lips during swallowing															
	Retrieval of Bolus															
	51. Hand used to wipe bolus outside of mouth															
	52. Lips used to retrieve food left outside of mouth															
	53. Teeth used to retrieve bolus outside of mouth															
	54. Upper teeth used to retrieve bolus from lower lip															
	55. Tongue used to retrieve bolus outside of mouth															
	56. Bolus outside of mouth is cleared															
	Cough															
	Choke															

	Gag															
	Expel / Spit out bolus															
	Vomit															

APPENDIX H: DEVELOPMENTAL QUESTIONNARIE

Child's name: _____ Date of birth: _____
Date form was completed: _____

When did your child begin to do the following? Please state the age in months. Please place an X in the Not yet column if your child does not currently have the skill listed.

Skill	Age (months)	Not yet
Roll		
Sit on own		
Crawl		
Pull self up along furniture		
Walk along furniture		
Walk on own		
Coo (vocalize, vocal play)		
Babble (random sounds)		
1ST meaningful word		

Please choose the answer that best describes the frequency with which you child does the following behaviors. Please place an X in the appropriate box. If you have not observed the behavior, or the item does not apply to your child, please put an X in the Never column.

Please use the following key when responding.

Always: When presented with the opportunity your child always responds in this manner.
Frequently: responds this way about 75% of the time
Occasionally: responds this way about 50% of the time
Seldom: responds this way about 25% of the time
Never: responds this way 0% of the time

Item	Oral Sensitivity	Always	Frequently	Occasionally	Seldom	Never
1	Suck thumb					
2	Use pacifier					
3	Put hands in mouth					
4	Put toys in mouth					
5	Gag with things in his/her mouth					
6	Excessive drooling without teething					

When did your child begin to eat the following foods? Please be as specific as possible. Circle Y for Yes if there were problems starting these foods and N for No if there were no problems starting these foods.

Age (months) started foods:	**Problems (describe):**
Bottle _____	Y N _____
Cereal by spoon _____	Y N _____
Fruits/vegetables _____	Y N _____
Stage 3 (smooth) _____	Y N _____
Stage 3 (lumpy/textured) ____	Y N _____
Finger foods _____	Y N _____
Table foods_____	Y N _____
Sipper vs. Open Cup_____	Y N _____

When healthy (not during illness), has your child ever had problems with the following items or does your child currently have problems with the following items during mealtime? Please mark an X in the boxes that described/s your child.

Item	In the past	Now	Does not apply
Slow feeder			
Takes small quantities			
Gagging			
Coughing			
Choking			
Refuses bottle			
Refuses formula			
Refuses cup			
Refuses foods from spoon			
Refuses solids			
Difficulty chewing solids			
Difficult to get into feeding routine			
Feeds on demand			
Does not eat enough			
Refuses to eat food offered			
Choosy or picky about food			
Definite likes and dislikes			
Refuses food with lumps or texture			

Please place an X in the boxes which best describe your child's current feeding status.

Please see the following examples*.

Stage 3 textured: puree with pieces of solids or lumps
Adult puree: applesauce, pudding, yogurt etc.
Dissolvable solids: foods that melt in your mouth with minimal chewing (i.e., graham crackers, butter crackers, Gerber puffs, Cheeto puffs)
Soft / well-cooked: soft vegetables, meats etc.
Crunchy: crisp crackers, chips etc.
General table food: foods that the parents eat cut into small pieces

Food item	Yes	No	# of times given per day
LIQUIDS			
Breast			
Bottle			
Formula			
Breast milk			
Juice			
PUREES			
Stage 1			
Stage 2			
Stage 3 smooth			
Stage 3 textured*			
Adult puree*			
SOLIDS			
Dissolvable*			
Soft / well-cooked*			
Crunchy*			
General table food*			
CUP			
Sipper cup (not spill-proof)			
Sipper cup with valve (spill-proof)			
Open / regular			
Straw			

Appendix I: Operational definitions and Scoring rules

Acceptance phase (1-30): from presentation of cracker or spoon to when the cracker or spoon (or hand) is removed from mouth
Manipulation phase (31-44): at point of cracker or spoon removal from mouth to end of manipulation movements
Transfer/swallow phase (45-50): from end of manipulation to when structures are at rest or mouth opened for next presentation is clear
Retrieval of bolus (51-56): attempt at retrieval of bolus lost from mouth at any stage

Scoring:

1. Score a "1" if the skill is observed
2. Score a "0" if the skill is not observed
3. If child moves from view of camera, turns away slightly from midline (to judge e.g. vertical jaw movement), parent interferes with view or cracker, spoon, or hand blocks view and skills cannot be assessed, score "." This includes if child takes another bite of cracker before swallowing previous or if rater simply cannot tell if skill was performed.
4. If a skill cannot be assessed due to the function of another skill, score "9" (e.g., lips closed during lateral movement of tongue)
5. If full bolus (i.e., piece of cracker) is lost from mouth and parent puts back into mouth, continue to score but score "bolus retrieved" as "0". If child puts back into mouth, continue to score but score "bolus retrieved" as "1".
6. For CW, if child takes another bite before swallowing previous bite, score previous trial up to that point and score "." for those skills not completed or observed. Scored the next bite from the beginning. After the last bite, score that trial completely. If cracker is held to mouth for extended time with no discernable bite and manipulation, score up to bite and any subsequent skills once cracker is removed.

*Child gets three attempts to accept presentation before considered as refused (only score presentation actually accepted)
*If manipulation and transfer/swallow phases are not discernable, score skills the same (i.e., 38 and 45; 39 and 46; 41 and 47; 42 and 49; 43 and 50). Circle the Trial number on page 2 if doing so.
*If child moves from view of camera while "chewing" but returns into view with same motions detected, continue scoring.

Acceptance

1. Brings head forward to cracker or spoon: Head movement forward to presentation. If already forward on first trial, score "1". If remains forward on subsequent trials, score "1".

2. Turns head to cracker or spoon: Movement of head to turn face towards the presentation. If already facing presentation on first trial, score "1". If remains facing for subsequent trials, score "1". If chin lifted upward towards presentation, score "1".

3. Looks at cracker or spoon: Eyes clearly locate and at least briefly attend to the presentation. If already looking at presentation, score "1".

4. Leans towards cracker or spoon: Torso moves towards presentation. If already forward, score "1".

5. Reaches for cracker or spoon: Hand moves towards presentation. If already holding cracker, score "1".

6. Holds head steady slightly forward in midline to accept the cracker or spoon: Head held in neutral/natural position through acceptance (spoon/cracker removed from mouth). If already in this position, score "1". If head is turned towards the shoulder or excessive head movements, head flexion or head extension observed, score "0".

7. Opens mouth when cracker or spoon is brought to mouth: Mouth opens as presentation moves towards the mouth. Score "0" if mouth opens when spoon is held in front of mouth and movement of spoon stops to wait for opening (unless the child is still clearly chewing). Score "0" if presentation held at lips before child opens mouth.

8. Jaw opens vertically in midline during acceptance: Jaw opens with downward motion in midline. Chin is not observed to shift to the right or the left of midline during this motion. If head turned away from camera, score ".".

9. Opens mouth before cracker or spoon touches lips: Any mouth opening before presentation touches lips. For CP or CW trial, score "1" if cracker is held at lips and then mouth opens. Score "0" if cracker is held at mouth

and the mouth does not open or if the mouth initially opened for the presentation and then closed, only to open when the lips were touched.
10. Mouth opens enough for cracker or spoon to enter: Mouth is observed at the height of opening. Score "1" if the amount of opening would accommodate the size of the presentation without touching lips. For CP trial, score "1" if mouth opens enough to accommodate the size of cracker. For CW trial, score "1" if mouth opens enough to accommodate a bite of the cracker.
11. Mouth remains open for cracker or spoon to enter mouth: Mouth does not begin to close until full bolus (i.e., full piece of solid; puree) enters the mouth (this does not mean the full spoon must enter mouth). For CP, score "0" if piece is held to lips, mouth opens but then closes (even if to open again for placement in the mouth). For CW, the presentation must have entered into the mouth and motion of entering cracker has stopped.
12. Tongue remains in mouth while cracker or spoon enters: Tongue does not move forward between the lips or beyond the lips as spoon or cracker enters the mouth. Score "8" if tongue retracts behind lips with full spoon insertion.
13. Upper lip touches cracker or spoon: Once the cracker or spoon enters the mouth, the entire upper lip moves to touch the top of the cracker, bolus or finger placing CP. If spoon is scraped upward against upper lip, score "1". If entire lip is not visible due to hand or cracker, score ".".
14. Lower lip touches bottom of cracker or spoon: Once the spoon or cracker enters the mouth, the entire lower lip moves to touch the bottom of the cracker, spoon or finger placing CP. If cracker or spoon is blocking view of lower lip, score "."
15. Lips touch cracker or spoon: Both the upper lip and the lower lip touch the cracker, spoon or finger placing CP once it has entered the mouth.
16. Gums or teeth are not used to remove bolus: If both lips do not touch cracker or spoon, the gums or teeth do not touch it for attempt at removal of bolus. If 13-15 observed, score "9".
17. Bolus removed from spoon with both lips: Both the upper lip and lower lip maintain touch on the spoon or cracker as removed from the mouth. Score "1" if 13 and 14 is a "0" but lips close as spoon is being removed.
18. Cracker or spoon is removed from mouth without resistance: No biting or holding of the cracker or spoon in the mouth as it is removed from the mouth.
19. Food not observed outside of mouth: No portion of bolus (even smallest crumb) noted on lips or chin during acceptance of the presentation. This should be observed as the spoon or cracker has just passed the lips during removal. Saliva does not count.
20. Lower lip draws inward after removal of cracker or spoon: Lower lip pulls inward as very first movement after cracker or spoon is removed. Score "8" if lower lip is moves inward during removal or already inward with spoon or cracker removal and observe movement back to baseline.
21. Spoon is cleared: The spoon has no discernable bolus remaining on any part of the spoon after removal from the mouth. Score "1" even if bolus is scraped off on the upper lip. If the spoon is not cleared and re-presented immediately by the parent, continue scoring same trial but score this skill as "0". Score "8" if solid is scraped into mouth on lip or gums.
22. No bolus loss from mouth during acceptance: Entire bolus remains in the mouth during acceptance of the presentation. This should be observed after the spoon is removed from the mouth and just prior to manipulation.
OMITTED 23. Bolus loss during acceptance into mouth: ANY portion of the bolus (even smallest crumb) noted to exit the mouth immediately following removal of the spoon or cracker (with very first movement).
Biting
24. Lips touch cracker during biting: Both the upper lip and lower lip maintain touch on the cracker when placed in the mouth during biting or attempts at biting.
25. Gums or teeth contact cracker during biting: Score "1" if gums or teeth touch cracker or if cracker is noticeably held by more than lips or if bite occurs clearly with gums or teeth. Score "9" if lips are closed. If lips are closed but bite through cracker in one motion without breaking off piece, score "1".
26. Bites on right side of mouth behind incisors: Placement of cracker behind (child's) right incisors (pre-molar or molar area) to bite or attempt to bite.
27. Bites on left side of mouth behind incisors: Placement of cracker behind (child's) left incisors (pre-molar or molar area) to bite or attempt to bite.
28. Bites in front of mouth: Placement of cracker in area of central / lateral incisors to bite or attempt to bite.
29. Attempts to bite instead of only tasting or licking: Cracker is brought to mouth or accepted to mouth and may be inserted in the mouth and biting motion is observed.

30. Bites completely through cracker in one motion: Attempts to bite cracker and succeeds in one motion. If biting motion is observed but is unsuccessful, score "0". Breaking piece off during the bite should be scored as "1". If cracker is held to mouth for extended period with multiple biting motions without removing, score "0". Score "1" if by motion and audio it is clear that one motion biting was successful, even if hand was blocking view.
Bolus Manipulation
31. Bolus moved to right cheek with tongue: Bolus observed to right of midline of tongue (not on tongue). If lips are closed and tongue motion cannot be observed, score "9". If lips are open and still cannot determine (just can't see), score ".". If cheek bulges or movement observed showing presence of bolus and lips are closed, score "1". Score "0" if bolus appears immediately swallowed with no bulging of cheeks or any other motion.
32. Bolus moved to left cheek with tongue: Bolus observed to left of midline of tongue (not on tongue). If lips are closed and tongue motion cannot be observed, score "9". If lips are open and still cannot determine, score ".". If cheek bulges or movement observed showing presence of bolus and lips are closed, score "1". Score "0" if bolus appears immediately swallowed with no bulging of cheeks or any other motion.
33. No assistance from fingers to move bolus in mouth: Parent or child does not place fingers in mouth during bolus manipulation appearing to move the location of the bolus.
34. Chewing initiated after bolus enters mouth: Discernable downward and upward jaw motions occurring with "noticeable regularity/recurring pattern" in any direction more than one time. You may observe both 34 and 35. This observation is made solely by looking at the chin.
35. Up and down jaw movement when bolus is in mouth: At least one obvious downward and upward motion of the jaw in any direction once the bolus enters the mouth and spoon or cracker is removed. This motion may only occur one time or more than one time but randomly (without regularity). If jaw appears to move only slightly back and forth, score "0". You may observe both 34 and 35. This observation is made solely by looking at the chin.
36. Jaw moves in various directions during bolus manipulation: Jaw is observed to shift to the right or left of midline during this motion. Jaw does not only open and close in midline or vertical plane.
37. No repetitive up/down tongue movement during bolus manipulation: Tongue does not move upward toward roof of mouth and downward to floor of mouth more than one time in sequence with noticeable regularity (no pauses between motions). If lips are closed, score "9". If lips are open but still cannot determine, score ".".
38. Holds head steady slightly forward in midline during bolus manipulation: Head held in neutral/natural position to shoulders throughout bolus manipulation. If already in this position, score "1". If head is turned towards should or excessive head movements, head flexion or head extension observed, score "0".
39. Lips closed during entire bolus manipulation: Lips remain closed until completion of bolus manipulation.
40. Lips are closed intermittently during bolus manipulation: Lips open at any time during manipulation of the bolus.
41. No bolus loss during bolus manipulation: The entire bolus remains in the mouth during manipulation of the bolus.
42. Tongue remains in mouth during bolus manipulation: The tongue remains behind the lips during manipulation of the bolus.
OMITTED 43. Tongue protrudes beyond lips: Tongue moves forward between the lips or beyond the lips at any time during manipulation of the bolus.
44. No repetitive forward/backward tongue movement during manipulation: Tongue motion forward between the lips or beyond the lips and backwards behind gums / teeth more than one time in sequence with noticeable regularity (no pauses between motions).
Transfer and Swallow of Bolus:
45. Holds head steady slightly forward in midline during swallowing: Head held in neutral/natural position to shoulders throughout transfer and swallow. If already in this position, score "1". If head is turned toward shoulder or excessive head movements, head flexion or head extension observed, score "0".
46. Keeps lips closed during swallowing: Lips remain closed until completion of the swallow.
47. No bolus loss while pushing it backwards to swallow: Entire bolus remains in the mouth during bolus transfer and swallow.
OMITTED 48. Loss of bolus from mouth: Any portion of bolus noted to exit the mouth during bolus transfer and swallow.
49. Tongue remains in mouth as bolus is pushed backwards to swallow: Tongue remains behind the lips

during bolus transfer and swallow.
OMITTED 50. Tongue protrudes beyond lips during swallowing: Tongue motion forward between or beyond the lips during swallowing.
Retrieval of Bolus: If bolus observed outside of mouth and any of these motions are observed, score "1". If the motion if observed without observation of bolus outside of the mouth, score "0".
51. Hand used to wipe bolus outside of mouth: Hand motion towards bolus on lips or chin in attempt to retrieve or place back inside mouth.
52. Lips used to retrieve food left outside of mouth: Either upper lip or lower lip motion to retrieve bolus from opposite lip (e.g., lower lip retrieves from upper lip). If 20 is observed (lower lips draws inward with spoon removal), score "1". If only 20 is observed, score "0".
53. Teeth used to retrieve bolus outside of mouth: Either upper teeth or lower teeth motion to retrieve bolus from opposite lip (e.g., lower teeth retrieves from upper lip).
54. Upper teeth used to retrieve bolus from lower lip during bolus manipulation: Upper teeth motion to retrieve bolus from lower lip.
55. Tongue used to retrieve bolus outside of mouth: Tongue motion outside of mouth between the lips or beyond the lips to retrieve bolus.
56. Bolus outside of mouth is cleared: No discernable bolus is observed on lips or chin after retrieval attempt. If more than one episode of each is observed, score "1" if all bolus is cleared; score "0" if not.

Raters will note any "problems" observed during the trial to include: Score "1" if observed; "0" if not observed

1. Cough (sudden noisy expulsion of air from the lungs)
2. Choke (struggle for breath; have insufficient oxygen intake)
3. Gag (reflex consisting of retching; mouths opens, tongue comes forward)
4. Expel / spit out bolus (eject bolus from mouth)
5. Vomit (eject the contents of the stomach into or out of mouth)

Appendix J: Intra- rater agreement for each oral-motor skill (OMS) across textures and for each texture for 9 children (8 month group: subjects 16, 41, 48; 10 month group: subjects 3, 6, 27, 54; 12 month group: subjects 4 and 55). Denominator differs per texture as not all children took all textures. N/A denotes a skill not relevant to texture. Note: SP=smooth puree; TP=textured puree; S=diced solids; CP=cracker piece; and CW=cracker whole

OMS	Total # times agree	Total %	SP # agree of 27	SP % agree	TP # agree of 27	TP % agree	S # agree of 15	S % agree	CP # agree of 20	CP % agree	CW agree of 21	CW % agree
1	96/110	86.49%	23	85.19%	25	92.59%	12	80%	18	90%	18	85.71%
2	103/110	92.79%	24	88.89%	26	96.30%	13	86.67%	19	95%	21	100%
3	103/110	92.79%	24	88.89%	25	92.59%	15	100%	20	100%	19	90.48%
4	101/110	90.99%	26	96.30%	26	96.30%	13	86.67%	18	90%	18	85.71%
5	109/110	98.20%	27	100%	27	100%	14	93.33%	20	100%	21	100%
6	98/110	88.29%	23	85.19%	23	85.19%	15	100%	17	85%	20	95.24%
7	100/110	90.09%	27	100%	24	88.89%	14	93.33%	17	85%	18	85.71%
8	101/110	90.99%	26	96.30%	25	92.59%	15	100%	17	85%	18	85.71%
9	95/110	85.59%	24	88.89%	24	88.89%	14	93.33%	15	75%	18	85.71%
10	105/110	94.59%	27	100%	25	92.59%	15	100%	18	90%	20	95.24%
11	94/110	84.68%	23	85.19%	23	85.19%	12	80%	16	80%	20	95.24%
12	108/110	97.30%	27	100%	27	100%	15	100%	19	95%	20	95.24%
13	103/110	92.79%	27	100%	27	100%	14	93.33%	15	75%	20	95.24%
14	104/110	93.69%	27	100%	27	100%	15	100%	15	75%	20	95.24%
15	104/110	93.69%	27	100%	27	100%	14	93.33%	16	80%	20	95.24%
16	69/69	100%	27	100%	27	100%	15	100%	n/a	n/a	n/a	n/a
17	67/69	97.10%	26	96.30%	26	96.30%	15	100%	n/a	n/a	n/a	n/a
18	89/90	98.89%	27	100%	26	96.30%	15	100%	n/a	n/a	21	100%
19	101/110	90.99%	24	88.89%	24	88.89%	14	93.33%	19	95%	20	95.24%
20	87/110	78.38%	22	81.48%	22	81.48%	8	53.33%	16	80%	19	90.48%
21	62/69	89.86%	23	85.19%	25	92.59%	14	93.33%	n/a	n/a	n/a	n/a
22	103/110	92.79%	24	88.89%	26	96.30%	14	93.33%	20	100%	19	90.48%
24	21/21	100%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21	100%
25	16/21	76.19%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	16	76.19%
26	21/21	100%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21	100%

OMS	Total # times agree	Total %	SP # agree of 27	SP % agree	TP # agree of 27	TP % agree	S # agree of 15	S % agree	CP # agree of 20	CP % agree	CW agree of 21	CW % agree
27	21/21	100%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21	100%
28	21/21	100%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21	100%
29	21/21	100%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21	100%
30	21/21	100%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21	100%
31	63/83	75%	n/a	n/a	18	66.67%	14	93.33%	15	75%	16	76.19%
32	63/83	75%	n/a	n/a	16	59.26%	13	86.67%	17	85%	17	80.95%
33	107/110	96.40%	26	96.30%	27	100%	14	93.33%	20	100%	20	95.24%
34	88/110	79.28%	18	66.67%	21	77.78%	12	80%	17	85%	20	95.24%
35	81/110	72.97%	17	62.96%	22	81.48%	9	60%	18	90%	15	71.43%
36	92/110	82.88%	21	77.78%	20	74.07%	14	93.33%	19	95%	18	85.71%
37	95/110	85.59%	23	85.19%	19	70.37%	15	100%	19	95%	19	90.48%
38	95/110	85.59%	18	66.67%	25	92.59%	15	100%	18	90%	19	90.48%
39	108/110	97.30%	26	96.30%	26	96.30%	15	100%	20	100%	21	100%
40	107/110	96.40%	26	96.30%	26	96.30%	15	100%	20	100%	20	95.24%
41	100/110	90.09%	24	88.89%	25	92.59%	14	93.33%	20	100%	17	80.95%
42	98/110	88.29%	27	100%	22	81.48%	13	86.67%	17	85%	19	90.48%
44	101/110	90.99%	24	88.89%	27	100%	14	93.33%	20	100%	16	76.19%
45	92/110	82.88%	18	66.67%	23	85.19%	15	100%	16	80%	20	95.24%
46	101/110	90.99%	26	96.30%	25	92.59%	15	100%	16	80%	19	90.48%
47	101/110	90.99%	24	88.89%	24	88.89%	15	100%	19	95%	19	90.48%
49	93/110	83.78%	25	92.59%	23	85.19%	10	66.67%	14	70%	21	100%
51	104/110	93.69%	25	92.59%	26	96.30%	15	100%	19	95%	19	90.48%
52	92/110	82.88%	22	81.48%	22	81.48%	14	93.33%	19	95%	15	71.43%
53	107/110	96.40%	26	96.30%	26	96.30%	15	100%	20	100%	20	95.24%
54	107/110	96.40%	26	96.30%	26	96.30%	15	100%	20	100%	20	95.24%
55	102/110	91.89%	26	96.30%	25	92.59%	14	93.33%	18	90%	19	90.48%
56	100/110	90.09%	22	81.48%	24	88.89%	15	100%	20	100%	19	90.48%
Total # (%) per texture	4441	90.63%	1045	90.01%	1095	90.12%	625	92.59%	736	89.7%	940	91.35%

Appendix K: Inter- rater agreement for each oral-motor skill (OMS) across textures and for each texture for 9 children (8 month group: subjects 16, 41, 48; 10 month group: subjects 3, 6, 27, 54; 12 month group: subjects 4 and 55). Denominator differs per texture as not all children took all textures. N/A denotes a skill not relevant to texture. Note: SP=smooth puree; TP=textured puree; S=diced solids; CP=cracker piece; and CW=cracker whole

OMS	Total # times agree	Total %	SP # agree of 27	SP % agree	TP # agree of 27	TP % agree	S # agree of 15	S % agree	CP # agree of 20	CP % agree	CW agree of 21	CW % agree
1	70/110	63.06%	19	70.37%	12	44.44%	10	66.67%	13	65%	15	71.43%
2	99/110	89.19%	24	88.89%	22	81.48%	12	80%	20	95%	21	100%
3	99/110	89.19%	26	96.30%	25	92.59%	9	60%	20	95%	19	90.48%
4	67/110	60.36%	15	55.56%	17	62.96%	6	40%	14	65%	15	71.43%
5	102/110	91.89%	27	100%	22	81.48%	11	73.33%	21	100%	21	100%
6	85/110	76.58%	19	70.37%	22	81.48%	9	60%	17	80%	18	85.71%
7	96/110	86.49%	27	100%	22	81.48%	11	73.33%	17	80%	19	90.48%
8	86/110	77.48%	24	88.89%	24	88.89%	12	80%	13	60%	13	61.90%
9	87/110	78.38%	21	77.78%	26	96.30%	11	73.33%	16	75%	13	61.90%
10	91/110	81.98%	25	92.59%	22	81.48%	11	73.33%	16	75%	17	80.95%
11	82/110	73.87%	21	77.78%	20	74.07%	10	66.67%	14	65%	17	80.95%
12	94/110	84.68%	26	96.30%	26	96.30%	12	80%	13	60%	17	80.95%
13	93/110	83.78%	25	92.59%	27	100%	10	66.67%	13	60%	18	85.71%
14	88/110	79.28%	23	85.19%	24	88.89%	11	73.33%	13	60%	17	80.95%
15	83/110	74.77%	22	81.48%	25	92.59%	10	66.67%	13	60%	13	61.90%
16	48/69	69.57%	17	62.96%	22	81.48%	9	60%	n/a	n/a	n/a	n/a
17	53/69	76.81%	20	74.07%	22	81.48%	11	73.33%	n/a	n/a	n/a	n/a
18	84/90	93.33%	27	100%	25	92.59%	11	73.33%	n/a	n/a	21	100%
19	94/110	84.68%	24	88.89%	24	88.89%	11	73.33%	16	75%	19	90.48%
20	60/110	54.05%	18	66.67%	18	66.67%	7	46.67%	7	30%	10	47.62%
21	51/69	73.91%	19	70.37%	21	77.78%	11	73.33%	n/a	n/a	n/a	n/a
22	86/110	77.48%	22	81.48%	20	74.07%	11	73.33%	18	85%	15	71.43%
24	15/21	71.43%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	15	71.43%
25	16/21	76.19%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	16	76.19%
26	19/21	90.48%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19	90.48%

OMS	Total # times agree	Total %	SP # agree of 27	SP % agree	TP # agree of 27	TP % agree	S # agree of 15	S % agree	CP # agree of 20	CP % agree	CW agree of 21	CW % agree
27	18/21	85.71%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	18	85.71%
28	19/21	90.48%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19	90.48%
29	21/21	100%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21	100%
30	19/21	90.48%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19	90.48%
31	55/83	65.48%	n/a	n/a	18	66.67%	8	53.33%	14	65%	15	71.43%
32	52/83	61.90%	n/a	n/a	17	62.96%	6	40%	17	80%	12	57.14%
33	94/110	84.68%	27	100%	24	88.89%	10	66.67%	16	75%	17	80.95%
34	82/110	73.87%	20	74.07%	25	92.59%	6	40%	14	65%	17	80.95%
35	74/110	66.67%	18	66.67%	17	62.96%	9	60%	19	90%	11	52.38%
36	63/110	56.76%	18	66.67%	21	77.78%	7	46.67%	8	35%	9	42.86%
37	44/110	39.64%	12	44.44%	9	33.33%	3	20%	12	55%	8	38.10%
38	83/110	74.77%	18	66.67%	18	66.67%	11	73.33%	16	75%	20	95.24%
39	99/110	89.19%	23	85.19%	23	85.19%	12	80%	21	100%	20	95.24%
40	98/110	88.29%	23	85.19%	23	85.19%	12	80%	21	100%	19	90.48%
41	95/110	85.59%	25	92.59%	24	88.89%	11	73.33%	19	90%	16	76.19%
42	82/110	73.87%	23	85.19%	22	81.48%	4	26.67%	14	65%	19	90.48%
44	98/110	88.29%	23	85.19%	25	92.59%	11	73.33%	20	95%	19	90.48%
45	87/110	78.38%	18	66.67%	24	88.89%	11	73.33%	16	75%	18	85.71%
46	90/110	81.08%	23	85.19%	23	85.19%	10	66.67%	19	90%	15	71.43%
47	92/110	82.88%	25	92.59%	21	77.78%	11	73.33%	18	85%	17	80.95%
49	82/110	73.87%	23	85.19%	21	77.78%	5	33.33%	14	65%	19	90.48%
51	95/110	85.59%	26	96.30%	22	81.48%	11	73.33%	18	85%	18	85.71%
52	76/110	68.47%	17	62.96%	18	66.67%	10	66.67%	18	85%	13	61.90%
53	96/110	86.49%	26	96.30%	23	85.19%	12	80%	21	100%	14	66.67%
54	98/110	88.29%	26	96.30%	24	88.89%	12	80%	21	100%	15	71.43%
55	91/110	81.98%	22	81.48%	24	88.89%	11	73.33%	21	100%	13	61.90%
56	86/110	77.48%	25	92.59%	19	70.37%	10	66.67%	19	90%	13	61.90%
Total # (%) per texture	3837	78.44%	952	82%	973	80.08%	439	65.04%	630	77%	802	77.94%

Appendix L: Number (%) of children in each age group performing each oral-motor skill (OMS) across all textures. Note that bolded items were performed at mastery level (performance by 75% or more of children within the group).

Age group	8 months	10 months		12 months	
OMS	Number (%)	OMS	Number (%)	OMS	Number (%)
1	33/74 (44.59%)	1	68/99 (68.69%)	1	71/101 (70.30%)
2	**73/74 (98.65%)**	2	**97/99 (97.98%)**	2	**100/101 (99.01%)**
3	**70/74 (94.59%)**	3	**86/99(86.87%)**	3	**92/101 (91.09%)**
4	20/74 (27.03%)	4	53/99 (53.54%)	4	39/101 (38.61%)
5	25/74 (33.78%)	5	46/99 (46.46%)	5	52/101 (51.49%)
6	**71/74 (95.95%)**	6	**96/99 (96.97%)**	6	**99/101 (98.02%)**
7	**72/74 (97.30%)**	**7**	**98/99 (98.99%)**	7	**100/101 (99.01%)**
8	**68/69 (98.55%)**	8	**82/82 (100%)**	8	**84/85 (98.82%)**
9	**69/74 (93.24%)**	9	**95/98 (96.94%)**	9	**98/101 (97.03%)**
10	**69/74 (93.24%)**	10	**94/98 (95.92%)**	10	**96/100 (96.00%)**
11	**58/74 (78.38%)**	11	68/98 (69.39%)	11	**77/99 (77.78%)**
12	**68/70 (97.14%)**	12	**78/83 (93.98%)**	12	**78/88 (88.64%)**
13	**67/74 (90.54%)**	13	**91/98 (92.86%)**	13	**88/99 (88.89%)**
14	**66/73 (90.41%)**	14	**84/91 (92.31%)**	14	**87/96 (90.63%)**
15	**65/73 (89.04%)**	15	**84/91 (92.31%)**	15	**84/96 (87.50%)**
16	**6/6 (100%)**	16	0/1 (0%)	16	2/4 (50%)
17	**49/51 (96.08%)**	17	**59/60 (98.33%)**	17	**54/59 (91.53%)**
18	**61/61 (100%)**	18	**80/80 (100%)**	18	**80/80 (100%)**
19	52/74 (70.27%)	19	71/99 (71.72%)	19	**82/101 (81.19%**

Age group	8 months	10 months		12 months	
OMS	Number (%)	OMS	Number (%)	OMS	Number (%)
20	52/74 (70.27%)	20	67/99 (67.68%)	20	56/101 (55.45%)
21	29/50 (58%)	21	29/60 (48.33%)	21	33/59 (55.93%)
22	**74/74 (100%)**	22	**98/98 (100%)**	22	**101/101 (100%)**
24	**7/9 (77.78%)**	24	**10/13 (76.92%)**	24	**15/19 (78.95%)**
25	**10/10 (100%)**	25	**20/20 (100%)**	25	**21/21 (100%)**
26	3/10 (30%)	26	4/20 (20%)	26	4/21 (19.05%)
27	2/10 (20%)	27	4/20 (20%)	27	2/21 (9.52%)
28	**9/10 (90%)**	28	**20/20 (100%)**	28	**21/21 (100%)**
29	**9/10 (90%)**	29	**18/20 (90%)**	29	**20/21 (95.24%)**
30	3/10 (30%)	30	13/20 (65%)	30	**16/21 (76.19%)**
31	18/27 (66.67%)	31	26/44 (59.09%)	31	22/42 (52.38%)
32	12/22 (54.55%)	32	25/38 (65.79%)	32	24/43 (55.81%)
33	**71/73 (97.26%)**	33	**95/97 (97.94%)**	33	**93/98 (94.90%)**
34	**62/73 (84.93%)**	34	**76/97 (78.35%)**	34	**79/98 (80.61%)**
35	**65/73 (89.04%)**	35	**84/97 (86.60%)**	35	**81/98 (82.65%)**
36	52/70 (74.29%)	36	68/93 (73.12%)	36	**74/96 (77.08%)**
37	**55/61 (90.16%)**	37	**81/83 (97.59%)**	37	**85/89 (95.51%)**
38	**68/73 (93.15%)**	38	**91/97 (93.81%)**	38	**96/98 (97.96%)**
39	14/73 (19.18%)	39	19/97 (19.59%)	39	17/98 (17.35%)
40	**67/73 (91.78%)**	40	**92/97 (94.85%)**	40	**90/98 (91.84%)**

Age group OMS	8 months Number (%)	10 months OMS	Number (%)	12 months OMS	Number (%)
41	**72/73 (98.63%)**	41	**93/97 (95.88%)**	41	**90/98 (91.84%)**
42	**63/73 (86.30%)**	42	**76/97 (78.35%)**	42	**80/97 (82.47%)**
44	**71/73 (97.26%)**	44	**96/97 (98.97%)**	44	**92/97 (94.85%)**
45	**65/71 (91.55%)**	45	**89/94 (94.68%)**	45	**92/93 (98.92%)**
46	16/71 (22.54%)	46	21/94 (22.34%)	46	25/93 (26.88%
47	**68/71 (95.77%)**	47	**91/94 (96.81%)**	47	**88/93 (94.62%)**
49	**59/71 (83.10%)**	49	**72/94 (76.60%)**	49	**77/93 (82.80%)**
51	10/55 (18.18%)	51	28/72 (38.89%)	51	25/65 (38.46%)
52	39/55 (70.91%)	52	**66/72 (91.67%)**	52	**50/65 (76.92%)**
53	0/55 (0%)	53	0/72 (0%)	53	2/65 (3.08%)
54	0/55 (0%)	54	1/72 (1.39%)	54	4/65 (6.15%)
55	16/55 (29.09%)	55	24/72 (33.33%)	55	22/65 (33.85%)
56	14/55 (25.45%)	56	31/72 (43.06%)	56	28/65 (43.08%)

Appendix M: Inferential statistics for age contrasts for each oral-motor skill (OMS) across all textures. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	8 vs. 10	-.241	171	.074	-3.259	.001*
	8 vs. 12	-.257	173	.073	-3.521	.001*
	10 vs. 12	-.016	198	.065	-.246	.806
OMS2	8 vs. 10	.007	171	.020	.332	.741
	8 vs. 12	-.004	173	.016	-.221	.825
	10 vs. 12	-.010	198	.017	-.597	.551
OMS3	8 vs. 10	.077	171	.046	1.693	.092
	8 vs. 12	.035	173	.040	.870	.385
	10 vs. 12	-.042	198	.044	-.951	.343
OMS4	8 vs. 10	-.265	171	.074	-3.602	.000*
	8 vs. 12	-.116	173	.072	-1.604	.110
	10 vs. 12	.149	198	.070	2.130	.034*
OMS5	8 vs. 10	-.127	171	.075	-1.682	.094
	8 vs. 12	-.177	173	.075	-2.354	.020*
	10 vs. 12	-.050	198	.071	-.707	.480
OMS6	8 vs. 10	-.010	171	.028	-.362	.718
	8 vs. 12	-.021	173	.026	-.810	.419
	10 vs. 12	-.011	198	.022	-.473	.636
OMS7	8 vs. 10	-.017	171	.020	-.841	.402
	8 vs. 12	-.017	173	.020	-.859	.391
	10 vs. 12	.000	198	.014	-.014	.989
OMS8	8 vs. 10	-.014	149	.013	-1.091	.277
	8 vs. 12	-.003	152	.018	-.148	.883
	10 vs. 12	.012	165	.012	.982	.327

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS9	8 vs. 10	-.037	170	.032	-1.137	.257
	8 vs. 12	-.038	173	.032	-1.183	.239
	10 vs. 12	-.001	197	.024	-.037	.970
OMS10	8 vs. 10	-.027	170	.034	-.777	.438
	8 vs. 12	-.028	172	.034	-.809	.420
	10 vs. 12	-.001	196	.028	-.029	.977
OMS11	8 vs. 10	.090	170	.068	1.318	.189
	8 vs. 12	.006	171	.064	.094	.925
	10 vs. 12	-.084	195	.063	-1.335	.183
OMS12	8 vs. 10	.032	151	.034	.931	.354
	8 vs. 12	.085	156	.042	2.018	.045*
	10 vs. 12	.053	169	.043	1.232	.220
OMS13	8 vs. 10	-.023	170	.042	-.547	.585
	8 vs. 12	.017	171	.047	.350	.727
	10 vs. 12	.040	195	.041	.964	.336
OMS14	8 vs. 10	-.019	162	.044	-.430	.668
	8 vs. 12	-.002	167	.046	-.047	.963
	10 vs. 12	.017	185	.041	.409	.683
OMS15	8 vs. 10	-.033	162	.045	-.718	.474
	8 vs. 12	.015	167	.050	.305	.760
	10 vs. 12	.048	185	.044	1.085	.279
OMS16	8 vs. 10	1.000	5	.000	.	.
	8 vs. 12	.500	8	.228	2.191	.060
	10 vs. 12	-.500	3	.645	-.775	.495
OMS17	8 vs. 10	-.023	109	.031	-.725	.470
	8 vs. 12	.046	108	.047	.971	.334
	10 vs. 12	.068	117	.040	1.703	.091

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS19	8 vs. 10	-.014	171	.070	-.207	.837
	8 vs. 12	-.109	173	.065	-1.689	.093
	10 vs. 12	-.095	198	.060	-1.581	.115
OMS20	8 vs. 10	.026	171	.072	.362	.718
	8 vs. 12	.148	173	.074	2.005	.047*
	10 vs. 12	.122	198	.069	1.783	.076
OMS21	8 vs. 10	.097	108	.096	1.007	.316
	8 vs. 12	.021	107	.096	.215	.830
	10 vs. 12	-.076	117	.092	-.825	.411
OMS24	8 vs. 10	.009	20	.191	.045	.965
	8 vs. 12	-.012	26	.172	-.068	.946
	10 vs. 12	-.020	30	.154	-.132	.896
OMS26	8 vs. 10	.100	28	.169	.593	.558
	8 vs. 12	.110	29	.165	.664	.512
	10 vs. 12	.010	39	.127	.075	.941
OMS27	8 vs. 10	.000	28	.160	.000	1.000
	8 vs. 12	.105	29	.132	.795	.433
	10 vs. 12	.105	39	.112	.936	.355
OMS28	8 vs. 10	-.100	28	.069	-1.440	.161
	8 vs. 12	-.100	29	.068	-1.477	.150
	10 vs. 12					
OMS29	8 vs. 10	.000	28	.120	.000	1.000
	8 vs. 12	-.052	29	.097	-.539	.594
	10 vs. 12	-.052	39	.083	-.631	.532
OMS30	8 vs. 10	-.350	28	.189	-1.854	.074
	8 vs. 12	-.462	29	.173	-2.663	.012*
	10 vs. 12	-.112	39	.145	-.774	.444

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS31	8 vs. 10	.076	69	.120	.631	.530
	8 vs. 12	.143	67	.122	1.168	.247
	10 vs. 12	.067	84	.108	.620	.537
OMS32	8 vs. 10	-.112	58	.132	-.854	.397
	8 vs. 12	-.013	63	.132	-.096	.924
	10 vs. 12	.100	79	.110	.910	.366
OMS33	8 vs. 10	-.007	168	.024	-.287	.774
	8 vs. 12	.024	169	.031	.768	.444
	10 vs. 12	.030	193	.027	1.139	.256
OMS34	8 vs. 10	.066	168	.061	1.084	.280
	8 vs. 12	.043	169	.059	.731	.466
	10 vs. 12	-.023	193	.058	-.389	.698
OMS35	8 vs. 10	.024	168	.051	.477	.634
	8 vs. 12	.064	169	.055	1.167	.245
	10 vs. 12	.039	193	.052	.761	.448
OMS36	8 vs. 10	.012	161	.070	.166	.868
	8 vs. 12	-.028	164	.068	-.414	.679
	10 vs. 12	-.040	187	.063	-.628	.531
OMS37	8 vs. 10	-.074	142	.038	-1.934	.055
	8 vs. 12	-.053	148	.042	-1.287	.200
	10 vs. 12	.021	170	.028	.741	.459
OMS38	8 vs. 10	-.007	168	.038	-.173	.863
	8 vs. 12	-.048	169	.031	-1.572	.118
	10 vs. 12	-.041	193	.028	-1.459	.146
OMS39	8 vs. 10	-.004	168	.062	-.066	.947
	8 vs. 12	.018	169	.060	.306	.760
	10 vs. 12	.022	193	.056	.401	.689

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS40	8 vs. 10	-.031	168	.038	-.801	.424
	8 vs. 12	-.001	169	.043	-.013	.990
	10 vs. 12	.030	193	.036	.839	.402
OMS41	8 vs. 10	.028	168	.026	1.049	.296
	8 vs. 12	.068	169	.034	1.979	.049*
	10 vs. 12	.040	193	.034	1.172	.243
OMS42	8 vs. 10	.080	168	.060	1.328	.186
	8 vs. 12	.038	168	.057	.673	.502
	10 vs. 12	-.041	192	.057	-.721	.472
OMS44	8 vs. 10	-.017	168	.020	-.834	.405
	8 vs. 12	.024	168	.031	.781	.436
	10 vs. 12	.041	192	.025	1.662	.098
OMS45	8 vs. 10	-.031	163	.039	-.795	.428
	8 vs. 12	-.074	162	.032	-2.340	.021*
	10 vs. 12	-.042	185	.026	-1.650	.101
OMS46	8 vs. 10	.002	163	.066	.030	.976
	8 vs. 12	-.043	162	.069	-.634	.527
	10 vs. 12	-.045	185	.063	-.718	.474
OMS47	8 vs. 10	-.010	163	.030	-.349	.727
	8 vs. 12	.012	162	.034	.337	.736
	10 vs. 12	.022	185	.030	.735	.463
OMS49	8 vs. 10	.065	163	.064	1.020	.309
	8 vs. 12	.003	162	.060	.051	.960
	10 vs. 12	-.062	185	.059	-1.051	.295
OMS51	8 vs. 10	-.207	125	.081	-2.571	.011*
	8 vs. 12	-.203	118	.082	-2.477	.015*
	10 vs. 12	.004	135	.084	.051	.959

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS52	8 vs. 10	-.208	125	.066	-3.157	.002*
	8 vs. 12	-.060	118	.081	-.745	.458
	10 vs. 12	.147	135	.061	2.426	.017*
OMS53	8 vs. 10					
	8 vs. 12	-.031	118	.023	-1.310	.193
	10 vs. 12	-.031	135	.021	-1.501	.136
OMS54	8 vs. 10	-.014	125	.016	-.873	.384
	8 vs. 12	-.062	118	.033	-1.883	.062
	10 vs. 12	-.048	135	.032	-1.486	.140
OMS55	8 vs. 10	-.042	125	.084	-.506	.613
	8 vs. 12	-.048	118	.086	-.554	.581
	10 vs. 12	-.005	135	.081	-.063	.950
OMS56	8 vs. 10	-.176	125	.085	-2.073	.040*
	8 vs. 12	-.176	118	.087	-2.035	.044*
	10 vs. 12	.000	135	.085	-.003	.998

Appendix N: Number (%) of children in the 8-month age group performing each oral-motor skill (OMS) for each texture. Note that bolded items were performed at mastery level (performance by 75% or more of children within the group). N/A denotes a skill not relevant to texture.

8 months OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
1	7/21 (33.33%)	7/16 (43.75%)	7/14 (50%)	9/13 (69.23%)	3/10 (30%)
2	**20/21 (95.24%)**	**16/16 (100%)**	**14/14 (100%)**	**13/13 (100%)**	**10/10 (100%)**
3	**19/21 (90.48%)**	**14/16 (87.50%)**	**14/14 (100%)**	**13/13 (100%)**	**10/10 (100%)**
4	4/21 (19.05%)	5/16 (31.25%)	3/14 (21.43%)	5/13 (38.46%)	3/10 (30%)
5	3/21 (14.29%)	1/16 (6.25%)	3/14 (21.43%)	9/13 (69.23%)	**9/10 (90%)**
6	**20/21 (95.24%)**	**14/16 (87.50%)**	**14/14 (100%)**	**13/13 (100%)**	**10/10 (100%)**
7	**21/21 (100%)**	**15/16 (93.75%)**	**14/14 (100%)**	**12/13 (92.31%)**	**10/10 (100%)**
8	**20/21 (95.24%)**	**16/16 (100%)**	**14/14 (100%)**	**10/10 (100%)**	**8/8 (100%)**
9	**20/21 (95.24%)**	**15/16 (93.75%)**	**12/14 (85.71%)**	**12/13 (92.31%)**	**10/10 (100%)**
10	**19/21 (90.48%)**	**14/16 (87.50%)**	**13/14 (92.86%)**	**13/13 (100%)**	**10/10 (100%)**
11	1121 (52.38%)	11/16 (68.75%)	**14/14 (100%)**	**12/13 (92.31%)**	**10/10 (100%)**
12	**21/21 (100%)**	**16/16 (100%)**	**14/14 (100%)**	**9/10 (90%)**	**8/9 (88.89%)**
13	**21/21 (100%)**	**16/16 (100%)**	**13/14 (92.86%)**	8/13 (61.54%)	**9/10 (90%)**
14	**21/21 (100%)**	**16/16 (100%)**	**14/14 (100%)**	7/13 (53.85%)	**8/9 (88.89%)**
15	**21/21 (100%)**	**16/16 (100%)**	**13/14 (92.86%)**	7/13 (53.85%)	**8/9 (88.89%)**
16	**1/1 (100%)**	**2/2 (100%)**	**3/3 (100%)**	n/a	n/a
17	**20/21 (95.24%)**	**16/16 (100%)**	**13/14 (92.86%)**	n/a	n/a
18	**21/21 (100%)**	**16/16 (100%)**	**14/14 (100%)**	n/a	**10/10 (100%)**

8 months OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
19	8/12 (38.10%)	8/16 (50%)	**14/14 (100%)**	**13/13 (100%)**	**9/10 (90%)**
20	**16/21 (76.19%)**	11/16 (68.75%)	10/14 (71.43%)	7/13 (53.85%)	**8/10 (80%)**
21	9/21 (42.86%)	7/15 (46.67%)	**13/14 (92.86%)**	n/a	n/a
22	**21/21 (100%)**	**16/16 (100%)**	**14/14 (100%)**	**13/13 (100%)**	**10/10 (100%)**
24	n/a	n/a	n/a	n/a	**7/9 (77.78%)**
25	n/a	n/a	n/a	n/a	**10/10 (100%)**
26	n/a	n/a	n/a	n/a	3/10 (30%)
27	n/a	n/a	n/a	n/a	2/10 (20%)
28	n/a	n/a	n/a	n/a	**9/10 (90%)**
29	n/a	n/a	n/a	n/a	**9/10 (90%)**
30	n/a	n/a	n/a	n/a	3/10 (30%)
31	n/a	1/7 (14.29%)	3/5 (60%)	**10/10 (100%)**	**4/5 (80%)**
32	n/a	0/6 (0%)	**3/4 (75%)**	**6/8 (75%)**	**3/4 (75%)**
33	**21/21 (100%)**	**16/16 (100%)**	**14/14 (100%)**	**12/13 (92.31%)**	**8/9 (88.89%)**
34	15/21 (71.43%)	**13/16 (81.25%)**	**13/14 (92.86%)**	**12/13 (92.31%)**	**9/9 (100%)**
35	**19/21 (90.48%)**	**14/16 (87.50%)**	**12/14 (85.71%)**	**13/13 (100%)**	**7/9 (77.78%)**
36	13/21 (61.90%)	11/15 (73.33%)	**12/14 (85.71%)**	**11/13 (84.62%)**	5/7 (71.43%)
37	**12/14 (85.71%)**	**12/14 (85.71%)**	**11/12 (91.67%)**	**12/13 (92.31%)**	**8/8 (100%)**
38	**21/21 (100%)**	**13/16 (81.25%)**	**12/14 (85.71%)**	**13/13 (100%)**	**9/9 (100%)**
39	7/21 (33.33%)	4/16 (25%)	1/14 (7.14%)	0/13 (0%)	2/9 (22.22%)

8 months OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
40	**18/21 (85.71%)**	**14/16 (87.50%)**	**14/14 (100%)**	**13/13 (100%)**	**8/9 (88.89%)**
41	**21/21 (100%)**	**16/16 (100%)**	**14/14 (100%)**	**12/13 (92.31%)**	**9/9 (100%)**
42	**20/21 (95.24%)**	**13/16 (81.25%)**	**12/14 (85.71%)**	**11/13 (84.62%)**	**7/9 (77.78%)**
44	**20/21 (95.24%)**	**16/16 (100%)**	**14/14 (100%)**	**12/13 (92.31%)**	**9/9 (100%)**
45	**21/21 (100%)**	**13/16 (81.25%)**	**10/13 (76.92%)**	**13/13 (100%)**	**8/8 (100%)**
46	8/21 (38.10%)	4/16 (25%)	2/13 (15.38%)	0/13 (0%)	2/8 (25%)
47	**21/21 (100%)**	**16/16 (100%)**	**13/13 (100%)**	**12/13 (92.31%)**	**6/8 (75%)**
49	**19/21 (90.48%)**	**13/16 (81.25%)**	**10/13 (76.92%)**	**11/13 (84.62%)**	**6/8 (75%)**
51	1/21 (4.76%)	3/15 (20%)	1/8 (12.50%)	2/4 (50%)	3/7 (42.86%)
52	**17/21 (80.95%)**	11/15 (73.33%)	5/8 (62.50%)	2/4 (50%)	4/7 (57.14%)
53	0/21 (0%)	0/15 (0%)	0/8 (0%)	0/4 (0%)	0/7 (0%)
54	0/21 (0%)	0/15 (0%)	0/8 (0%)	0/4 (0%)	0/7 (0%)
55	8/21 (38.10%)	7/15 (46.67%)	1/8 (12.50%)	0/4 (0%)	0/7 (0%)
56	3/21 (14.29%)	3/15 (20%)	2/8 (25%)	**3/4 (75%)**	3/7 (42.86%)

Appendix O: Number (%) of children in the 10-month age group performing each oral-motor skill (OMS) for each texture. Note that bolded items were performed at mastery level (performance by 75% or more of children within the group). N/A denotes a skill not relevant to texture.

10 months OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
1	15/21 (71.43%)	15/21 (71.43%)	12/18 (66.67%)	13/19 (68.42%)	13/20 (65%)
2	**21/21 (100%)**	**20/21 (95.24%)**	**18/18 (100%)**	**19/19 (100%)**	**19/20 (95%)**
3	**18/21 (85.71%)**	**16/21 (76.19%)**	**17/18 (94.44%)**	**18/19 (94.74%)**	**17/20 (85%)**
4	10/21 (47.62%)	13/21 (61.90%)	10/18 (55.56%)	11/19 (57.89%)	9/20 (45%)
5	0/21 (0%)	4/21 (19.05%)	4/18 (22.22%)	**19/19 (100%)**	**19/20 (95%)**
6	**21/21 (100%)**	**21/21 (100%)**	**17/18 (94.44%)**	**18/19 (94.74%)**	**19/20 (95%)**
7	**21/21 (100%)**	**21/21 (100%)**	**18/18 (100%)**	**19/19 (100%)**	**19/20 (95%)**
8	**20/20 (100%)**	**21/21 (100%)**	**18/18 (100%)**	**10/10 (100%)**	**13/13 (100%)**
9	**21/21 (100%)**	**21/21 (100%)**	**18/18 (100%)**	**16/18 (88.89%)**	**19/20 (95%)**
10	**19/21 (90.48%)**	**20/21 (95.24%)**	**18/18 (100%)**	**17/18 (94.44%)**	**20/20 (100%)**
11	8/21 (38.10%)	10/21 (47.62%)	**15/18 (83.33%)**	**15/18 (83.33%)**	**20/20 (100%)**
12	**19/21 (90.48%)**	**21/21 (100%)**	**17/18 (94.44%)**	**12/12 (100%)**	**9/11 (81.82%)**
13	**21/21 (100%)**	**21/21 (100%)**	**18/18 (100%)**	**14/18 (77.78%)**	**17/20 (85%)**
14	**21/21 (100%)**	**21/21 (100%)**	**18/18 (100%)**	**14/18 (77.78%)**	**10/13 (76.92%)**
15	**21/21 (100%)**	**21/21 (100%)**	**18/18 (100%)**	**14/18 (77.78%)**	**10/13 (76.92%)**
16	n/a	n/a	0/1 (0%)	n/a	n/a
17	**21/21 (100%)**	**20/21 (95.24%)**	**18/18 (100%)**	n/a	n/a
18	**21/21 (100%)**	**21/21 (100%)**	**18/18 (100%)**	n/a	**20/20 (100%)**

10 months OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
19	9/21 (42.86%)	9/21 (42.86%)	**17/18 (94.44%)**	**19/19 (100%)**	**17/20 (85%)**
20	14/21 (66.67%)	13/21 (61.90%)	11/18 (61.11%)	12/19 (63.16%)	**17/20 (85%)**
21	5/21 (23.81%)	7/21 (33.33%)	**17/18 (94.44%)**	n/a	n/a
22	**21/21 (100%)**	**21/21 (100%)**	**18/18 (100%)**	**19/19 (100%)**	**19/19 (100%)**
24	n/a	n/a	n/a	n/a	**10/13 (76.92%)**
25	n/a	n/a	n/a	n/a	**20/20 (100%)**
26	n/a	n/a	n/a	n/a	4/20 (20%)
27	n/a	n/a	n/a	n/a	4/20 (20%)
28	n/a	n/a	n/a	n/a	**20/20 (100%)**
29	n/a	n/a	n/a	n/a	**18/20 (90%)**
30	n/a	n/a	n/a	n/a	13/20 (65%)
31	n/a	2/8 (25%)	**7/9 (77.78%)**	**11/13 (84.62%)**	6/14 (42.86%)
32	n/a	1/7 (14.29%)	5/8 (62.50%)	**9/9 (100%)**	10/14 (71.43%)
33	**21/21 (100%)**	**20/21 (95.24%)**	**17/18 (94.44%)**	**19/19 (100%)**	**18/18 (100%)**
34	11/21 (52.38%)	14/21 (66.67%)	**16/18 (88.89%)**	**18/19 (94.74%)**	**17/18 (94.44%)**
35	**16/21 (76.19%)**	**19/21 (90.48%)**	**15/18 (83.33%)**	**18/19 (94.74%)**	**16/18 (88.89%)**
36	8/19 (42.11%)	15/21 (71.43%)	**15/18 (83.33%)**	**16/18 (88.89%)**	**14/17 (82.35%)**
37	**14/15 (93.33%)**	**15/16 (93.75%)**	**16/16 (100%)**	**18/18 (100%)**	**18/18 (100%)**
38	**20/21 (95.24%)**	**21/21 (100%)**	**16/18 (88.89%)**	**16/19 (84.21%)**	**18/18 (100%)**
39	9/21 (42.86%)	7/21 (33.33%)	0/18 (0%)	2/19 (10.53%)	1/18 (5.56%)
40	**17/21 (80.95%)**	**20/21 (95.24%)**	**18/18 (100%)**	**19/19 (100%)**	**18/18 (100%)**

10 months OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
41	**21/21 (100%)**	**19/21 (90.48%)**	**17/18 (94.44%)**	**19/19 (100%)**	**17/18 (94.44%)**
42	**18/21 (85.71%)**	**16/21 (76.19%)**	12/18 (66.67%)	**15/19 (78.95%)**	**15/18 (83.33%)**
44	**21/21 (100%)**	**21/21 (100%)**	**17/18 (94.44%)**	**19/19 (100%)**	**18/18 (100%)**
45	**21/21 (100%)**	**20/21 (95.24%)**	**15/16 (93.75%)**	**17/19 (89.47%)**	**16/17 (94.12%)**
46	9/21 (42.86%)	7/21 (33.33%)	0/16 (0%)	3/19 (15.79%)	2/17 (11.76%)
47	**21/21 (100%)**	**19/21 (90.48%)**	**15/16 (93.75%)**	**19/19 (100%)**	**17/17 (100%)**
49	**18/21 (85.71%)**	**16/21 (76.19%)**	10/16 (62.50%)	**15/19 (78.95%)**	**13/17 (76.47%)**
51	1/20 (5%)	7/21 (33.33%)	4/9 (44.44%)	6/9 (66.67%)	**10/13 (76.92%)**
52	**18/20 (90%)**	**21/21 (100%)**	**7/9 (77.78%)**	**9/9 (100%)**	**11/13 (84.62%)**
53	0/20 (0%)	0/21 (0%)	0/9 (0%)	0/9 (0%)	0/13 (0%)
54	0/20 (0%)	0/21 (0%)	0/9 (0%)	0/9 (0%)	1/13 (7.69%)
55	9/20 (45%)	9/21 (42.86%)	2/9 (22.22%)	2/9 (22.22%)	2/13 (15.38%)
56	4/20 (20%)	6/21 (28.57%)	6/9 (66.67%)	**7/9 (77.78%)**	8/13 (61.54%)

Appendix P: Number (%) of children in the 12-month age group performing each oral-motor skill (OMS) for each texture. Note that bolded items were performed at mastery level (performance by 75% or more of children within the group). N/A denotes a skill not relevant to texture.

12 months OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
1	11/21 (52.38%)	**15/20 (75%)**	11/18 (61.11%)	**18/21 (85.71%)**	**16/21 (76.19%)**
2	**21/21 (100%)**	**20/20 (100%)**	**17/18 (94.44%)**	**21/21 (100%)**	**21/21 (100%)**
3	**19/21 (90.48%)**	**16/20 (80%)**	**17/18 (94.44%)**	**19/21 (90.48%)**	**21/21 (100%)**
4	5/21 (23.81%)	5/20 (25%)	9/18 (50%)	9/21 (42.86%)	11/21 (52.38%)
5	2/21 (9.52%)	3/20 (15%)	5/18 (27.78%)	**21/21 (100%)**	**21/21 (100%)**
6	**20/21 (95.24%)**	**20/20 (100%)**	**17/18 (94.44%)**	**21/21 (100%)**	**21/21 (100%)**
7	**21/21 (100%)**	**20/20 (100%)**	**18/18 (100%)**	**20/21 (95.24%)**	**21/21 (100%)**
8	**21/21 (100%)**	**20/20 (100%)**	**17/18 (94.44%)**	**11/11 (100%)**	**15/15 (100%)**
9	**21/21 (100%)**	**20/20 (100%)**	**18/18 (100%)**	**19/21 (90.48%)**	**20/21 (95.24%)**
10	**19/21 (90.48%)**	**19/20 (95%)**	**17/18 (94.44%)**	**20/20 (100%)**	**21/21 (100%)**
11	9/21 (42.86%)	14/20 (70%)	**16/18 (88.89%)**	**18/20 (90%)**	**20/20 (100%)**
12	**18/21 (85.71%)**	**18/20 (90%)**	**15/18 (83.33%)**	**14/15 (93.33%)**	**13/14 (92.86%)**
13	**21/21 (100%)**	**20/20 (100%)**	**17/18 (94.44%)**	14/20 (70%)	**16/20 (80%)**
14	**21/21 (100%)**	**20/20 (100%)**	**17/18 (94.44%)**	13/20 (65%)	**16/17 (94.12%)**
15	**21/21 (100%)**	**20/20 (100%)**	**16/18 (88.89%)**	13/20 (65%)	**14/17 (82.35%)**
16	n/a	**1/1 (100%)**	1/3 (33.33%)	n/a	n/a
17	**21/21 (100%)**	**19/20 (95%)**	**14/18 (77.78%)**	n/a	n/a
18	**21/21 (100%)**	**20/20 (100%)**	**18/18 (100%)**	n/a	**21/21 (100%)**

12 months OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
19	13/21 (61.90%)	14/20 (70%)	**15/18 (83.33%)**	**21/21 (100%)**	**19/21 (90.48%)**
20	11/21 (52.38%)	11/20 (55%)	7/18 (38.89%)	13/21 (61.90%)	14/21 (66.67%)
21	7/21 (33.33%)	10/20 (50%)	**16/18 (88.89%)**	n/a	n/a
22	**21/21 (100%)**	**20/20 (100%)**	**18/18 (100%)**	**21/21 (100%)**	**21/21 (100%)**
24	n/a	n/a	n/a	n/a	**15/19 (78.95%)**
25	n/a	n/a	n/a	n/a	**21/21 (100%)**
26	n/a	n/a	n/a	n/a	4/21 (19.05%)
27	n/a	n/a	n/a	n/a	2/21(9.52%)
28	n/a	n/a	n/a	n/a	**21/21 (100%)**
29	n/a	n/a	n/a	n/a	**20/21 (95.24%)**
30	n/a	n/a	n/a	n/a	**16/21 (76.19%)**
31	n/a	2/12 (16.67%)	4/8 (50%)	**9/11 (81.82%)**	7/11 (63.64%)
32	n/a	1/12 (8.33%)	4/7 (57.14%)	**11/13 (84.62%)**	8/11 (72.73%)
33	**21/21 (100%)**	**19/20 (95%)**	**17/18 (94.44%)**	**19/21 (90.48%)**	**17/18 (94.44%)**
34	14/21 (66.67%)	**15/20 (75%)**	**1518 (83.33%)**	**18/21 (85.71%)**	**17/18 (94.44%)**
35	**16/21 (76.19%)**	**15/20 (75%)**	**15/18 (83.33%)**	**19/21 (90.48%)**	**16/18 (88.89%)**
36	9/20 (45%)	**15/20 (75%)**	**15/18 (83.33%)**	**19/21 (90.48%)**	**16/17 (94.12%)**
37	**14/16 (87.50%)**	**17/19 (89.47%)**	**17/17 (100%)**	**20/20 (100%)**	**17/17 (100%)**
38	**21/21 (100%)**	**20/20 (100%)**	**18/18 (100%)**	**19/21 (90.48%)**	**18/18 (100%)**
39	8/21 (38.10%)	6/20 (30%)	2/18 (11.11%)	0/21 (0%)	1/18 (5.56%)
40	**17/21 (80.95%)**	**18/20 (90%)**	**17/18 (94.44%)**	**21/21 (100%)**	**17/18 (94.44%)**

12 months OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
41	**21/21 (100%)**	**19/20 (95%)**	**15/18 (83.33%)**	**18/21 (85.71%)**	**17/18 (94.44%)**
42	**18/21 (85.71%)**	**17/20 (85%)**	12/18 (66.67%)	**16/21 (76.19%)**	**17/17 (100%)**
44	**18/21 (85.71%)**	**19/20 (95%)**	**18/18 (100%)**	**20/21 (95.24%)**	**17/17 (100%)**
45	**21/21 (100%)**	**20/20 (100%)**	**17/17 (100%)**	**18/19 (94.74%)**	**16/16 (100%)**
46	9/21 (42.86%)	7/20 (35%)	3/17 (17.65%)	4/19 (21.05%)	2/16 (12.50%)
47	**21/21 (100%)**	**19/20 (95%)**	**15/17 (88.24%)**	**18/19 (94.74%)**	**15/16 (93.75%)**
49	**18/21 (85.71%)**	**16/20 (80%)**	12/17 (70.59%)	**15/19 (78.95%)**	**16/16 (100%)**
51	2/18 (11.11%)	8/17 (47.06%)	4/9 (44.44%)	5/10 (50%)	6/11 (54.55%)
52	**17/18 (94.44%)**	**13/17 (76.47%)**	6/9 (66.67%)	7/10 (70%)	7/11 (63.64%)
53	1/18 (5.56%)	1/17 (5.88%)	0/9 (0%)	0/10 (0%)	0/11 (0%)
54	1/18 (5.56%)	1/17 (5.88%)	0/9 (0%)	0/10 (0%)	2/11 (18.18%)
55	10/18 (55.56%)	6/17 (35.29%)	4/9 (44.44%)	1/10 (10%)	1/11 (9.09%)
56	6/18 (33.33%)	5/17 (29.41%)	4/9 (44.44%)	7/10 (70%)	6/11 (54.55%)

Appendix Q: Inferential statistics for t-tests for age contrasts for each oral-motor skill (OMS) within smooth puree texture. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	8 vs. 10	-.381	40	.146	-2.609	0.013*
	8 vs. 12	-.190	40	.154	-1.240	0.222
	10 vs. 12	.190	40	.151	1.265	0.213
OMS2	8 vs. 10	-.048	40	.048	-1.000	0.323
	8 vs. 12	-.048	40	.048	-1.000	0.323
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS3	8 vs. 10	.048	40	.102	.466	0.644
	8 vs. 12	.000	40	.093	.000	1.000
	10 vs. 12	-.048	40	.102	-.466	0.644
OMS4	8 vs. 10	-.286	40	.142	-2.011	0.051
	8 vs. 12	-.048	40	.130	-.368	0.715
	10 vs. 12	.238	40	.147	1.622	0.113
OMS5	8 vs. 10	.143	40	.078	1.826	0.075
	8 vs. 12	.048	40	.102	.466	0.644
	10 vs. 12	-.095	40	.066	-1.451	0.155
OMS6	8 vs. 10	-.048	40	.048	-1.000	0.323
	8 vs. 12	.000	40	.067	.000	1.000
	10 vs. 12	.048	40	.048	1.000	0.323
OMS8	8 vs. 10	-.048	39	.049	-.975	0.335
	8 vs. 12	-.048	40	.048	-1.000	0.323
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS9	8 vs. 10	-.048	40	.048	-1.000	0.323
	8 vs. 12	-.048	40	.048	-1.000	0.323
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS10	8 vs. 10	.000	40	.093	.000	1.000
	8 vs. 12	.000	40	.093	.000	1.000
	10 vs. 12	.000	40	.093	.000	1.000
OMS11	8 vs. 10	.143	40	.156	.917	0.365
	8 vs. 12	.095	40	.157	.606	0.548
	10 vs. 12	-.048	40	.155	-.307	0.760

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS12	8 vs. 10	.095	40	.066	1.451	0.155
	8 vs. 12	.143	40	.078	1.826	0.075
	10 vs. 12	.048	40	.102	.466	0.644
OMS17	8 vs. 10	-.048	40	.048	-1.000	0.323
	8 vs. 12	-.048	40	.048	-1.000	0.323
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS19	8 vs. 10	-.048	40	.155	-.307	0.760
	8 vs. 12	-.238	40	.154	-1.550	0.129
	10 vs. 12	-.190	40	.155	-1.229	0.226
OMS20	8 vs. 10	.095	40	.142	.670	0.506
	8 vs. 12	.238	40	.147	1.622	0.113
	10 vs. 12	.143	40	.154	.930	0.358
OMS21	8 vs. 10	.190	40	.146	1.305	0.199
	8 vs. 12	.095	40	.153	.623	0.537
	10 vs. 12	-.095	40	.142	-.670	0.506
OMS34	8 vs. 10	.190	40	.151	1.265	0.213
	8 vs. 12	.048	40	.146	.326	0.746
	10 vs. 12	-.143	40	.154	-.930	0.358
OMS35	8 vs. 10	.143	40	.116	1.235	0.224
	8 vs. 12	.143	40	.116	1.235	0.224
	10 vs. 12	.000	40	.135	.000	1.000
OMS36	8 vs. 10	.198	38	.159	1.245	0.221
	8 vs. 12	.169	39	.157	1.074	0.290
	10 vs. 12	-.029	37	.163	-.178	0.860
OMS37	8 vs. 10	-.076	27	.116	-.655	0.518
	8 vs. 12	-.018	28	.129	-.139	0.891
	10 vs. 12	.058	29	.109	.534	0.598
OMS38	8 vs. 10	.048	40	.048	1.000	0.323
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.048	40	.048	-1.000	0.323
OMS39	8 vs. 10	-.095	40	.153	-.623	0.537
	8 vs. 12	-.048	40	.151	-.315	0.755
	10 vs. 12	.048	40	.155	.307	0.760

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS40	8 vs. 10	.048	40	.118	.405	0.688
	8 vs. 12	.048	40	.118	.405	0.688
	10 vs. 12	.000	40	.124	.000	1.000
OMS42	8 vs. 10	.095	40	.092	1.040	0.305
	8 vs. 12	.095	40	.092	1.040	0.305
	10 vs. 12	.000	40	.111	.000	1.000
OMS44	8 vs. 10	-.048	40	.048	-1.000	0.323
	8 vs. 12	.095	40	.092	1.040	0.305
	10 vs. 12	.143	40	.078	1.826	0.075
OMS46	8 vs. 10	-.048	40	.155	-.307	0.760
	8 vs. 12	-.048	40	.155	-.307	0.760
	10 vs. 12	.000	40	.156	.000	1.000
OMS49	8 vs. 10	.048	40	.102	.466	0.644
	8 vs. 12	.048	40	.102	.466	0.644
	10 vs. 12	.000	40	.111	.000	1.000
OMS51	8 vs. 10	-.002	39	.069	-.035	0.973
	8 vs. 12	-.063	37	.087	-.728	0.471
	10 vs. 12	-.061	36	.089	-.683	0.499
OMS52	8 vs. 10	-.090	39	.112	-.806	0.425
	8 vs. 12	-.135	37	.108	-1.249	0.219
	10 vs. 12	-.044	36	.090	-.495	0.623
OMS53	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	-.056	37	.051	-1.083	0.286
	10 vs. 12	-.056	36	.053	-1.056	0.298
OMS54	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	-.056	37	.051	-1.083	0.286
	10 vs. 12	-.056	36	.053	-1.056	0.298
OMS55	8 vs. 10	-.069	39	.157	-.439	0.663
	8 vs. 12	-.175	37	.162	-1.079	0.288
	10 vs. 12	-.106	36	.166	-.636	0.529
OMS56	8 vs. 10	-.057	39	.120	-.475	0.637
	8 vs. 12	-.190	37	.135	-1.407	0.168
	10 vs. 12	-.133	36	.145	-.918	0.365

Appendix R: Inferential statistics for t-tests for age contrasts for each oral-motor skill (OMS) within textured puree texture. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	8 vs. 10	-.277	35	.161	-1.721	.094
	8 vs. 12	-.313	34	.159	-1.959	.058
	10 vs. 12	-.036	39	.142	-.252	.803
OMS2	8 vs. 10	.048	35	.055	.870	.390
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.048	39	.049	-.975	.335
OMS3	8 vs. 10	.113	35	.132	.855	.398
	8 vs. 12	.075	34	.128	.586	.562
	10 vs. 12	-.038	39	.132	-.288	.775
OMS4	8 vs. 10	-.307	35	.162	-1.887	.068
	8 vs. 12	.063	34	.154	.405	.688
	10 vs. 12	.369	39	.148	2.501	.017*
OMS5	8 vs. 10	-.128	35	.115	-1.117	.272
	8 vs. 12	-.088	34	.107	-.815	.421
	10 vs. 12	.040	39	.120	.336	.738
OMS6	8 vs. 10	-.125	35	.074	-1.685	.101
	8 vs. 12	-.125	34	.076	-1.643	.110
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS7	8 vs. 10	-.063	35	.054	-1.151	.258
	8 vs. 12	-.063	34	.056	-1.122	.270
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS9	8 vs. 10	-.063	35	.054	-1.151	.258
	8 vs. 12	-.063	34	.056	-1.122	.270
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS10	8 vs. 10	-.077	35	.092	-.839	.407
	8 vs. 12	-.075	34	.095	-.793	.433
	10 vs. 12	.002	39	.069	.035	.973
OMS11	8 vs. 10	.211	35	.165	1.279	.209
	8 vs. 12	-.013	34	.159	-.079	.938
	10 vs. 12	-.224	39	.154	-1.456	.153

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS12	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	.100	34	.077	1.296	.204
	10 vs. 12	.100	39	.067	1.490	.144
OMS16	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	.000	1	.000	n/a	n/a
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS17	8 vs. 10	.048	35	.055	.870	.390
	8 vs. 12	.050	34	.056	.892	.379
	10 vs. 12	.002	39	.069	.035	.973
OMS19	8 vs. 10	.071	35	.170	.421	.676
	8 vs. 12	-.200	34	.165	-1.214	.233
	10 vs. 12	-.271	39	.153	-1.775	.084
OMS20	8 vs. 10	.068	35	.162	.421	.676
	8 vs. 12	.138	34	.167	.825	.415
	10 vs. 12	.069	39	.157	.439	.663
OMS21	8 vs. 10	.133	34	.168	.793	.433
	8 vs. 12	-.033	33	.176	-.190	.851
	10 vs. 12	-.167	39	.156	-1.071	.291
OMS31	8 vs. 10	-.107	13	.220	-.486	.635
	8 vs. 12	-.024	17	.183	-.130	.898
	10 vs. 12	.083	18	.191	.435	.669
OMS32	8 vs. 10	-.143	11	.155	-.920	.377
	8 vs. 12	-.083	16	.120	-.696	.496
	10 vs. 12	.060	17	.154	.387	.703
OMS33	8 vs. 10	.048	35	.055	.870	.390
	8 vs. 12	.050	34	.056	.892	.379
	10 vs. 12	.002	39	.069	.035	.973
OMS34	8 vs. 10	.146	35	.150	.975	.336
	8 vs. 12	.063	34	.143	.437	.665
	10 vs. 12	-.083	39	.145	-.574	.569

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS35	8 vs. 10	-.030	35	.106	-.281	.780
	8 vs. 12	.125	34	.135	.927	.361
	10 vs. 12	.155	39	.118	1.312	.197
OMS36	8 vs. 10	.019	34	.156	.122	.903
	8 vs. 12	-.017	33	.154	-.108	.914
	10 vs. 12	-.036	39	.142	-.252	.803
OMS37	8 vs. 10	-.080	28	.113	-.714	.481
	8 vs. 12	-.038	31	.118	-.317	.753
	10 vs. 12	.043	33	.098	.438	.664
OMS38	8 vs. 10	-.188	35	.088	-2.141	.039*
	8 vs. 12	-.188	34	.090	-2.088	.044*
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS39	8 vs. 10	-.083	35	.155	-.537	.595
	8 vs. 12	-.050	34	.154	-.324	.748
	10 vs. 12	.033	39	.149	.224	.824
OMS40	8 vs. 10	-.077	35	.092	-.839	.407
	8 vs. 12	-.025	34	.108	-.231	.819
	10 vs. 12	.052	39	.083	.631	.532
OMS41	8 vs. 10	.095	35	.075	1.262	.215
	8 vs. 12	.050	34	.056	.892	.379
	10 vs. 12	-.045	39	.083	-.544	.589
OMS42	8 vs. 10	.051	35	.140	.361	.720
	8 vs. 12	-.038	34	.128	-.292	.772
	10 vs. 12	-.088	39	.126	-.698	.489
OMS44	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	.050	34	.056	.892	.379
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS45	8 vs. 10	-.140	35	.103	-1.354	.184
	8 vs. 12	-.188	34	.090	-2.088	.044*
	10 vs. 12	-.048	39	.049	-.975	.335
OMS46	8 vs. 10	-.083	35	.155	-.537	.595
	8 vs. 12	-.100	34	.158	-.633	.531
	10 vs. 12	-.017	39	.152	-.110	.913

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS47	8 vs. 10	.095	35	.075	1.262	.215
	8 vs. 12	.050	34	.056	.892	.379
	10 vs. 12	-.045	39	.083	-.544	.589
OMS49	8 vs. 10	.051	35	.140	.361	.720
	8 vs. 12	.013	34	.137	.092	.928
	10 vs. 12	-.038	39	.132	-.288	.775
OMS51	8 vs. 10	-.133	34	.154	-.865	.393
	8 vs. 12	-.271	30	.167	-1.624	.115
	10 vs. 12	-.137	36	.162	-.846	.403
OMS52	8 vs. 10	-.267	34	.099	-2.686	.011*
	8 vs. 12	-.031	30	.158	-.198	.844
	10 vs. 12	.235	36	.095	2.474	.018*
OMS53	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	-.059	30	.063	-.938	.356
	10 vs. 12	-.059	36	.053	-1.115	.272
OMS54	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	-.059	30	.063	-.938	.356
	10 vs. 12	-.059	36	.053	-1.115	.272
OMS55	8 vs. 10	.038	34	.173	.221	.827
	8 vs. 12	.114	30	.178	.637	.529
	10 vs. 12	.076	36	.163	.463	.646
OMS56	8 vs. 10	-.086	34	.150	-.572	.571
	8 vs. 12	-.094	30	.157	-.598	.555
	10 vs. 12	-.008	36	.152	-.055	.956

Appendix S: Inferential statistics for t-tests for age contrasts on each oral-motor skill within solid texture. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	8 vs. 10	-.167	30	.178	-.935	.357
	8 vs. 12	-.111	30	.181	-.612	.545
	10 vs. 12	.056	34	.164	.338	.738
OMS2	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	.056	30	.063	.879	.387
	10 vs. 12	.056	34	.056	1.000	.324
OMS3	8 vs. 10	.056	30	.063	.879	.387
	8 vs. 12	.056	30	.063	.879	.387
	10 vs. 12	.000	34	.079	.000	1.000
OMS4	8 vs. 10	-.341	30	.170	-2.011	.053
	8 vs. 12	-.286	30	.170	-1.677	.104
	10 vs. 12	.056	34	.171	.325	.747
OMS5	8 vs. 10	-.008	30	.152	-.052	.959
	8 vs. 12	-.063	30	.159	-.399	.692
	10 vs. 12	-.056	34	.148	-.375	.710
OMS6	8 vs. 10	.056	30	.063	.879	.387
	8 vs. 12	.056	30	.063	.879	.387
	10 vs. 12	.000	34	.079	.000	1.000
OMS8	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	.056	30	.063	.879	.387
	10 vs. 12	.056	34	.056	1.000	.324
OMS9	8 vs. 10	-.143	30	.085	-1.677	.104
	8 vs. 12	-.143	30	.085	-1.677	.104
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS10	8 vs. 10	-.071	30	.063	-1.139	.264
	8 vs. 12	-.016	30	.089	-.178	.860
	10 vs. 12	.056	34	.056	1.000	.324
OMS11	8 vs. 10	.167	30	.103	1.620	.116
	8 vs. 12	.111	30	.087	1.281	.210
	10 vs. 12	-.056	34	.118	-.470	.641

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS12	8 vs. 10	.056	30	.063	.879	.387
	8 vs. 12	.167	30	.103	1.620	.116
	10 vs. 12	.111	34	.106	1.047	.302
OMS13	8 vs. 10	-.071	30	.063	-1.139	.264
	8 vs. 12	-.016	30	.089	-.178	.860
	10 vs. 12	.056	34	.056	1.000	.324
OMS14	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	.056	30	.063	.879	.387
	10 vs. 12	.056	34	.056	1.000	.324
OMS15	8 vs. 10	-.071	30	.063	-1.139	.264
	8 vs. 12	.040	30	.107	.371	.713
	10 vs. 12	.111	34	.076	1.458	.154
OMS16	8 vs. 10	1.000	2	.000	n/a	n/a
	8 vs. 12	.667	4	.333	2.000	.116
	10 vs. 12	-.333	2	.667	-.500	.667
OMS17	8 vs. 10	-.071	30	.063	-1.139	.264
	8 vs. 12	.151	30	.131	1.153	.258
	10 vs. 12	.222	34	.101	2.204	.034*
OMS19	8 vs. 10	.056	30	.063	.879	.387
	8 vs. 12	.167	30	.103	1.620	.116
	10 vs. 12	.111	34	.106	1.047	.302
OMS20	8 vs. 10	.103	30	.174	.594	.557
	8 vs. 12	.325	30	.174	1.872	.071
	10 vs. 12	.222	34	.167	1.329	.193
OMS21	8 vs. 10	-.016	30	.089	-.178	.860
	8 vs. 12	.040	30	.107	.371	.713
	10 vs. 12	.056	34	.094	.589	.560
OMS31	8 vs. 10	-.178	12	.267	-.665	.519
	8 vs. 12	.100	11	.307	.325	.751
	10 vs. 12	.278	15	.237	1.174	.259
OMS32	8 vs. 10	.125	10	.314	.398	.699
	8 vs. 12	.179	9	.328	.544	.599
	10 vs. 12	.054	13	.272	.197	.847

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS33	8 vs. 10	.056	30	.063	.879	.387
	8 vs. 12	.056	30	.063	.879	.387
	10 vs. 12	.000	34	.079	.000	1.000
OMS34	8 vs. 10	.040	30	.107	.371	.713
	8 vs. 12	.095	30	.120	.791	.435
	10 vs. 12	.056	34	.118	.470	.641
OMS35	8 vs. 10	.024	30	.134	.178	.860
	8 vs. 12	.024	30	.134	.178	.860
	10 vs. 12	.000	34	.128	.000	1.000
OMS36	8 vs. 10	.024	30	.134	.178	.860
	8 vs. 12	.024	30	.134	.178	.860
	10 vs. 12	.000	34	.128	.000	1.000
OMS37	8 vs. 10	-.083	26	.072	-1.162	.256
	8 vs. 12	-.083	27	.069	-1.200	.241
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS38	8 vs. 10	-.032	30	.122	-.261	.796
	8 vs. 12	-.143	30	.085	-1.677	.104
	10 vs. 12	-.111	34	.076	-1.458	.154
OMS39	8 vs. 10	.071	30	.063	1.139	.264
	8 vs. 12	-.040	30	.107	-.371	.713
	10 vs. 12	-.111	34	.076	-1.458	.154
OMS40	8 vs. 10	n/a	n/a	n/a	n/a	n/a
	8 vs. 12	.056	30	.063	.879	.387
	10 vs. 12	.056	34	.056	1.000	.324
OMS41	8 vs. 10	.056	30	.063	.879	.387
	8 vs. 12	.167	30	.103	1.620	.116
	10 vs. 12	.111	34	.106	1.047	.302
OMS42	8 vs. 10	.190	30	.156	1.225	.230
	8 vs. 12	.190	30	.156	1.225	.230
	10 vs. 12	.000	34	.162	.000	1.000
OMS44	8 vs. 10	.056	30	.063	.879	.387
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.056	34	.056	-1.000	.324

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS45	8 vs. 10	-.168	27	.129	-1.300	.205
	8 vs. 12	-.231	28	.106	-2.182	.038*
	10 vs. 12	-.063	31	.061	-1.032	.310
OMS46	8 vs. 10	.154	27	.093	1.646	.111
	8 vs. 12	-.023	28	.142	-.159	.875
	10 vs. 12	-.176	31	.098	-1.795	.082
OMS47	8 vs. 10	.063	27	.070	.898	.377
	8 vs. 12	.118	28	.092	1.272	.214
	10 vs. 12	.055	31	.103	.536	.596
OMS49	8 vs. 10	.144	27	.177	.815	.422
	8 vs. 12	.063	28	.168	.377	.709
	10 vs. 12	-.081	31	.169	-.479	.635
OMS51	8 vs. 10	-.319	15	.221	-1.447	.169
	8 vs. 12	-.319	15	.221	-1.447	.169
	10 vs. 12	.000	16	.248	.000	1.000
OMS52	8 vs. 10	-.153	15	.232	-.657	.521
	8 vs. 12	-.042	15	.247	-.169	.868
	10 vs. 12	.111	16	.222	.500	.624
OMS55	8 vs. 10	-.097	15	.196	-.497	.626
	8 vs. 12	-.319	15	.221	-1.447	.169
	10 vs. 12	-.222	16	.229	-.970	.346
OMS56	8 vs. 10	-.417	15	.235	-1.775	.096
	8 vs. 12	-.194	15	.242	-.803	.434
	10 vs. 12	.222	16	.242	.918	.372

Appendix T: Inferential statistics for t-tests for age contrasts on each oral-motor skills (OMS) within cracker piece texture. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	8 vs. 10	.008	30	.172	.047	.963
	8 vs. 12	-.165	32	.144	-1.143	.261
	10 vs. 12	-.173	38	.133	-1.303	.200
OMS3	8 vs. 10	.053	30	.064	.823	.417
	8 vs. 12	.095	32	.084	1.135	.265
	10 vs. 12	.043	38	.085	.500	.620
OMS4	8 vs. 10	-.194	30	.182	-1.065	.295
	8 vs. 12	-.044	32	.179	-.246	.807
	10 vs. 12	.150	38	.161	.936	.355
OMS5	8 vs. 10	-.308	30	.109	-2.814	.009*
	8 vs. 12	-.308	32	.104	-2.964	.006*
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS6	8 vs. 10	.053	30	.064	.823	.417
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.053	38	.050	-1.053	.299
OMS7	8 vs. 10	-.077	30	.063	-1.218	.233
	8 vs. 12	-.029	32	.085	-.343	.734
	10 vs. 12	.048	38	.050	.950	.348
OMS9	8 vs. 10	.034	29	.111	.308	.760
	8 vs. 12	.018	32	.103	.178	.860
	10 vs. 12	-.016	37	.100	-.159	.875
OMS10	8 vs. 10	.056	29	.066	.846	.405
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.056	36	.053	-1.056	.298
OMS11	8 vs. 10	.090	29	.125	.718	.479
	8 vs. 12	.023	31	.106	.219	.828
	10 vs. 12	-.067	36	.112	-.594	.556
OMS12	8 vs. 10	-.100	20	.091	-1.101	.284
	8 vs. 12	-.033	23	.115	-.289	.775
	10 vs. 12	.067	25	.075	.891	.381

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS13	8 vs. 10	-.162	29	.168	-.966	.342
	8 vs. 12	-.085	31	.173	-.490	.627
	10 vs. 12	.078	36	.146	.531	.599
OMS14	8 vs. 10	-.239	29	.170	-1.406	.170
	8 vs. 12	-.112	31	.178	-.625	.537
	10 vs. 12	.128	36	.150	.853	.400
OMS15	8 vs. 10	-.239	29	.170	-1.406	.170
	8 vs. 12	-.112	31	.178	-.625	.537
	10 vs. 12	.128	36	.150	.853	.400
OMS20	8 vs. 10	-.093	30	.182	-.512	.612
	8 vs. 12	-.081	32	.178	-.452	.655
	10 vs. 12	.013	38	.157	.080	.937
OMS31	8 vs. 10	.154	21	.119	1.288	.212
	8 vs. 12	.182	19	.128	1.418	.172
	10 vs. 12	.028	22	.159	.176	.862
OMS32	8 vs. 10	-.250	15	.154	-1.627	.125
	8 vs. 12	-.096	19	.184	-.522	.608
	10 vs. 12	.154	20	.126	1.220	.237
OMS33	8 vs. 10	-.077	30	.063	-1.218	.233
	8 vs. 12	.018	32	.103	.178	.860
	10 vs. 12	.095	38	.069	1.378	.176
OMS34	8 vs. 10	-.024	30	.090	-.270	.789
	8 vs. 12	.066	32	.117	.565	.576
	10 vs. 12	.090	38	.096	.936	.355
OMS35	8 vs. 10	.053	30	.064	.823	.417
	8 vs. 12	.095	32	.084	1.135	.265
	10 vs. 12	.043	38	.085	.500	.620
OMS36	8 vs. 10	-.043	29	.126	-.339	.737
	8 vs. 12	-.059	32	.117	-.502	.619
	10 vs. 12	-.016	37	.100	-.159	.875

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS37	8 vs. 10	-.077	29	.065	-1.185	.246
	8 vs. 12	-.077	31	.061	-1.251	.220
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS38	8 vs. 10	.158	30	.104	1.512	.141
	8 vs. 12	.095	32	.084	1.135	.265
	10 vs. 12	-.063	38	.107	-.586	.561
OMS39	8 vs. 10	-.105	30	.088	-1.197	.241
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	.105	38	.069	1.532	.134
OMS41	8 vs. 10	-.077	30	.063	-1.218	.233
	8 vs. 12	.066	32	.117	.565	.576
	10 vs. 12	.143	38	.082	1.734	.091
OMS42	8 vs. 10	.057	30	.145	.392	.698
	8 vs. 12	.084	32	.146	.576	.569
	10 vs. 12	.028	38	.136	.203	.840
OMS44	8 vs. 10	-.077	30	.063	-1.218	.233
	8 vs. 12	-.029	32	.085	-.343	.734
	10 vs. 12	.048	38	.050	.950	.348
OMS45	8 vs. 10	.105	30	.088	1.197	.241
	8 vs. 12	.053	30	.064	.823	.417
	10 vs. 12	-.053	36	.089	-.588	.560
OMS46	8 vs. 10	-.158	30	.104	-1.512	.141
	8 vs. 12	-.211	30	.117	-1.803	.081
	10 vs. 12	-.053	36	.129	-.408	.686
OMS47	8 vs. 10	-.077	30	.063	-1.218	.233
	8 vs. 12	-.024	30	.090	-.270	.789
	10 vs. 12	.053	36	.053	1.000	.324
OMS49	8 vs. 10	.057	30	.145	.392	.698
	8 vs. 12	.057	30	.145	.392	.698
	10 vs. 12	.000	36	.136	.000	1.000

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS51	8 vs. 10	-.167	11	.314	-.531	.606
	8 vs. 12	.000	12	.320	.000	1.000
	10 vs. 12	.167	17	.236	.705	.490
OMS52	8 vs. 10	-.500	11	.181	-2.760	.019*
	8 vs. 12	-.200	12	.301	-.665	.519
	10 vs. 12	.300	17	.161	1.858	.081
OMS55	8 vs. 10	-.222	11	.226	-.983	.347
	8 vs. 12	-.100	12	.162	-.617	.549
	10 vs. 12	.122	17	.175	.700	.493
OMS56	8 vs. 10	-.028	11	.275	-.101	.921
	8 vs. 12	.050	12	.288	.173	.865
	10 vs. 12	.078	17	.213	.365	.720

Appendix U: Inferential statistics for t-tests for age contrasts on each oral-motor skill (OMS) within cracker whole texture. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	8 vs. 10	-.350	28	.189	-1.854	.074
	8 vs. 12	-.462	29	.173	-2.663	.012*
	10 vs. 12	-.112	39	.145	-.774	.444
OMS2	8 vs. 10	.050	28	.071	.701	.489
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.050	39	.049	-1.025	.312
OMS3	8 vs. 10	.150	28	.117	1.283	.210
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.150	39	.080	-1.878	.068
OMS4	8 vs. 10	-.150	28	.194	-.772	.447
	8 vs. 12	-.224	29	.193	-1.158	.256
	10 vs. 12	-.074	39	.160	-.462	.647
OMS5	8 vs. 10	-.050	28	.100	-.502	.619
	8 vs. 12	-.100	29	.068	-1.477	.150
	10 vs. 12	-.050	39	.049	-1.025	.312
OMS6	8 vs. 10	.050	28	.071	.701	.489
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.050	39	.049	-1.025	.312
OMS7	8 vs. 10	.050	28	.071	.701	.489
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.050	39	.049	-1.025	.312
OMS9	8 vs. 10	.050	28	.071	.701	.489
	8 vs. 12	.048	29	.070	.684	.499
	10 vs. 12	-.002	39	.069	-.035	.973
OMS12	8 vs. 10	.071	18	.168	.420	.679
	8 vs. 12	-.040	21	.126	-.316	.755
	10 vs. 12	-.110	23	.135	-.820	.420
OMS13	8 vs. 10	.050	28	.136	.368	.716
	8 vs. 12	.100	28	.148	.675	.505
	10 vs. 12	.050	38	.123	.406	.687

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS14	8 vs. 10	.120	20	.173	.690	.498
	8 vs. 12	-.052	24	.114	-.459	.650
	10 vs. 12	-.172	28	.126	-1.370	.182
OMS15	8 vs. 10	.120	20	.173	.690	.498
	8 vs. 12	.065	24	.154	.424	.676
	10 vs. 12	-.054	28	.152	-.357	.724
OMS19	8 vs. 10	.050	28	.136	.368	.716
	8 vs. 12	-.005	29	.117	-.041	.968
	10 vs. 12	-.055	39	.104	-.524	.603
OMS20	8 vs. 10	-.050	28	.149	-.335	.740
	8 vs. 12	.133	29	.179	.747	.461
	10 vs. 12	.183	39	.134	1.364	.180
OMS24	8 vs. 10	.009	20	.191	.045	.965
	8 vs. 12	-.012	26	.172	-.068	.946
	10 vs. 12	-.020	30	.154	-.132	.896
OMS26	8 vs. 10	.100	28	.169	.593	.558
	8 vs. 12	.110	29	.165	.664	.512
	10 vs. 12	.010	39	.127	.075	.941
OMS27	8 vs. 10	.000	28	.160	.000	1.000
	8 vs. 12	.105	29	.132	.795	.433
	10 vs. 12	.105	39	.112	.936	.355
OMS28	8 vs. 10	-.100	28	.069	-1.440	.161
	8 vs. 12	-.100	29	.068	-1.477	.150
	10 vs. 12	n/a	n/a	n/a	n/a	n/a
OMS29	8 vs. 10	.000	28	.120	.000	1.000
	8 vs. 12	-.052	29	.097	-.539	.594
	10 vs. 12	-.052	39	.083	-.631	.532
OMS30	8 vs. 10	-.350	28	.189	-1.854	.074
	8 vs. 12	-.462	29	.173	-2.663	.012*
	10 vs. 12	-.112	39	.145	-.774	.444

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS31	8 vs. 10	.371	17	.260	1.429	.171
	8 vs. 12	.164	14	.264	.621	.545
	10 vs. 12	-.208	23	.205	-1.012	.322
OMS32	8 vs. 10	.036	16	.269	.133	.896
	8 vs. 12	.023	13	.277	.082	.936
	10 vs. 12	-.013	23	.189	-.069	.946
OMS33	8 vs. 10	-.111	25	.077	-1.443	.161
	8 vs. 12	-.056	25	.111	-.503	.620
	10 vs. 12	.056	34	.056	1.000	.324
OMS34	8 vs. 10	.056	25	.079	.700	.490
	8 vs. 12	.056	25	.079	.700	.490
	10 vs. 12	.000	34	.079	.000	1.000
OMS35	8 vs. 10	-.111	25	.149	-.745	.463
	8 vs. 12	-.111	25	.149	-.745	.463
	10 vs. 12	.000	34	.108	.000	1.000
OMS36	8 vs. 10	-.109	22	.189	-.578	.569
	8 vs. 12	-.227	22	.147	-1.539	.138
	10 vs. 12	-.118	32	.112	-1.050	.301
OMS39	8 vs. 10	.167	25	.129	1.291	.209
	8 vs. 12	.167	25	.129	1.291	.209
	10 vs. 12	.000	34	.079	.000	1.000
OMS40	8 vs. 10	-.111	25	.077	-1.443	.161
	8 vs. 12	-.056	25	.111	-.503	.620
	10 vs. 12	.056	34	.056	1.000	.324
OMS41	8 vs. 10	.056	25	.079	.700	.490
	8 vs. 12	.056	25	.079	.700	.490
	10 vs. 12	.000	34	.079	.000	1.000
OMS42	8 vs. 10	-.056	25	.164	-.338	.738
	8 vs. 12	-.222	24	.105	-2.117	.045*
	10 vs. 12	-.167	33	.093	-1.790	.083

OMS	Age contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS45	8 vs. 10	.059	23	.087	.678	.504
	8 vs. 12	n/a	n/a	n/a	n/a	n/a
	10 vs. 12	-.059	31	.061	-.969	.340
OMS46	8 vs. 10	.132	23	.162	.819	.421
	8 vs. 12	.125	22	.166	.751	.461
	10 vs. 12	-.007	31	.117	-.063	.950
OMS47	8 vs. 10	-.250	23	.109	-2.283	.032*
	8 vs. 12	-.188	22	.144	-1.301	.207
	10 vs. 12	.063	31	.061	1.032	.310
OMS49	8 vs. 10	-.015	23	.191	-.077	.939
	8 vs. 12	-.250	22	.113	-2.211	.038*
	10 vs. 12	-.235	31	.109	-2.151	.039*
OMS51	8 vs. 10	-.341	18	.222	-1.537	.142
	8 vs. 12	-.117	16	.255	-.459	.653
	10 vs. 12	.224	22	.196	1.142	.266
OMS52	8 vs. 10	-.275	18	.204	-1.347	.195
	8 vs. 12	-.065	16	.249	-.260	.798
	10 vs. 12	.210	22	.180	1.167	.256
OMS54	8 vs. 10	-.077	18	.106	-.725	.478
	8 vs. 12	-.182	16	.155	-1.176	.257
	10 vs. 12	-.105	22	.140	-.751	.461
OMS55	8 vs. 10	-.154	18	.144	-1.070	.299
	8 vs. 12	-.091	16	.115	-.789	.442
	10 vs. 12	.063	22	.141	.447	.659
OMS56	8 vs. 10	-.187	18	.242	-.772	.450
	8 vs. 12	-.117	16	.255	-.459	.653
	10 vs. 12	.070	22	.210	.332	.743

Appendix V: Performance level for each oral-motor skill (OMS) and texture by 8-month-old children. Performance level is indicated by "x" when 0-24%, 25-49%, 50-74% and 75-100% of children performed each skill. Note that bolded items and grayed areas are only to aid in discrimination of data. A "-" denotes when a skill is not relevant to the texture.

8 months																				
Performance Level																				
%	**0-24**					25-49					**50-74**					75-100				
OMS	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW
1						x	x			x			**x**	**x**						
2																x	x	x	x	x
3																x	x	x	x	x
4	**x**		**x**				x		x	x										
5	**x**	**x**	**x**											**x**						x
6																x	x	x	x	x
7																x	x	x	x	x
8																x	x	x	x	x
9																x	x	x	x	x
10																x	x	x	x	x
11											**x**	**x**						x	x	x
12																x	x	x	x	x
13														**x**		x	x	x		x
14														**x**		x	x	x		x
15														**x**		x	x	x		x
16				**-**	**-**				-	-				**-**	**-**	x	x	x	-	-
17				**-**	**-**				-	-				**-**	**-**	x	x	x	-	-
18				**-**					-					**-**		x	x	x	-	x
19						x						**x**						x	x	x
20												**x**	**x**	**x**		x				x
21				**-**	**-**	x	x		-	-				**-**	**-**			x	-	-
22																x	x	x	x	x
24	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
25	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
26	**-**	**-**	**-**	**-**		-	-	-	-	x	**-**	**-**	**-**	**-**		-	-	-	-	
27	**-**	**-**	**-**	**-**	**x**	-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	
28	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
29	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
30	**-**	**-**	**-**	**-**		-	-	-	-	x	**-**	**-**	**-**	**-**		-	-	-	-	
31	**-**	**x**				-					**-**		**x**			-			x	x
32	**-**	**x**				-					**-**					-		x	x	x
33																x	x	x	x	x
34											**x**						x	x	x	x
35																x	x	x	x	x
36											**x**	**x**			**x**			x	x	
37																x	x	x	x	x
38																x	x	x	x	x
39			**x**	**x**	**x**	x	x													
40																x	x	x	x	x
41																x	x	x	x	x
42																x	x	x	x	x
44																x	x	x	x	x
45																x	x	x	x	x
46			**x**	**x**		x	x			x										

8 months (continued)																				
Performance Level																				
%	0-24					25-49					50-74					75-100				
OMS	SP	TP	S	CP	CW	SP	TP	S	CP	CW	SP	TP	S	CP	CW	SP	TP	S	CP	CW
47																x	x	x	x	x
49																x	x	x	x	x
51	x	x	x							x				x						
52												x	x	x	x	x				
53	x	x	x	x	x															
54	x	x	x	x	x															
55			x	x	x	x	x													
56	x	x						x		x									x	

Appendix W: Performance level for each oral-motor skill (OMS) and texture by 10-month-old children. Performance level is indicated by "x" when 0-24%, 25-49%, 50-74% and 75-100% of children performed each skill. Note that bolded items and grayed areas are only to aid in discrimination of data. A "-" denotes when a skill is not relevant to the texture.

10 months																				
Performance Level																				
%	**0-24**					25-49					**50-74**					75-100				
OMS	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	C W
1											**x**	**x**	**x**	**x**	**x**					
2																x	x	x	x	x
3																x	x	x	x	x
4						x				x		**x**	**x**	**x**						
5	**x**	**x**	**x**																x	x
6																x	x	x	x	x
7																x	x	x	x	x
8																x	x	x	x	x
9																x	x	x	x	x
10																x	x	x	x	x
11						x	x											x	x	x
12																x	x	x	x	x
13																x	x	x	x	x
14																x	x	x	x	x
15																x	x	x	x	x
16			x	**-**	**-**				-	-				**-**	**-**				-	-
17				**-**	**-**				-	-				**-**	**-**	x	x	x	-	-
18				**-**					-					**-**		x	x	x	-	x
19						x	x											x	x	x
20											**x**	**x**	**x**	**x**						x
21	**x**			**-**	**-**		x		-	-				-	**-**			x	-	-
22																x	x	x	x	x
24	**-**	**-**	**-**	**-**		-	-	-	**-**		**-**	**-**	**-**	**-**		-	-	-	-	x
25	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
26	**-**	**-**	**-**	**-**	x	-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	
27	**-**	**-**	**-**	**-**	x	-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	
28	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
29	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
30	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**	**x**	-	-	-	-	
31	**-**					-	x			x	**-**					-		x	x	
32	**-**	**x**				-					**-**		**x**		**x**	-			x	
33																x	x	x	x	x
34											**x**	**x**						x	x	x
35																x	x	x	x	x
36						x						**x**						x	x	x
37																x	x	x	x	x
38																x	x	x	x	x
39			**x**	**x**	**x**	x	x													
40																x	x	x	x	x
41																x	x	x	x	x
42													**x**			x	x		x	x
44																x	x	x	x	x
45																x	x	x	x	x
46			**x**	**x**	**x**	x	x													
47																x	x	x	x	x
49													**x**			x	x		x	x
51	**x**						x	x						**x**						x

10 months (continued)																				
Performance Level																				
%	0-24					25-49					50-74					75-100				
OMS	SP	TP	S	CP	CW	SP	TP	S	CP	CW	SP	TP	S	CP	CW	SP	TP	S	CP	C W
52																x	x	x	x	x
53	x	x	x	x	x															
54	x	x	x	x	x															
55			x	x	x	x	x													
56	x						x						x		x				x	

Appendix X: Performance level for each oral-motor skill (OMS) and texture by 12-month-old children. Performance level is indicated by "x" when 0-24%, 25-49%, 50-74% and 75-100% of children performed each skill. Note that bolded items and grayed areas are only to aid in discrimination of data. A "-" denotes when a skill is not relevant to the texture.

12 months																				
Performance Level																				
%	**0-24**					25-49					**50-74**					75-100				
OMS	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW
1											**x**		**x**				x		x	x
2																x	x	x	x	x
3																x	x	x	x	x
4	**x**						x		x				**x**		**x**					
5	**x**	**x**						x											x	x
6																x	x	x	x	x
7																x	x	x	x	x
8																x	x	x	x	x
9																x	x	x	x	x
10																x	x	x	x	x
11						x						**x**						x	x	x
12																x	x	x	x	x
13														**x**		x	x	x		x
14														**x**		x	x	x		x
15														**x**		x	x	x		x
16				**-**	**-**			x	-	-				**-**	**-**		x		-	-
17				**-**	**-**				-	-				**-**	**-**	x	x	x	-	-
18				**-**					-					**-**		x	x	x	-	x
19											**x**	**x**						x	x	x
20								x			**x**	**x**		**x**	**x**					
21				**-**	**-**	x			-	-		**x**		**-**	**-**			x	-	-
22																x	x	x	x	x
24	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
25	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
26	**-**	**-**	**-**	**-**	**x**	-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	
27	**-**	**-**	**-**	**-**	**x**	-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	
28	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
29	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
30	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
31	**-**	**x**				-					**-**		**x**		**x**	-			x	
32	**-**	**x**				-					**-**		**x**		**x**	-			x	
33																x	x	x	x	x
34											**x**						x	x	x	x
35																x	x	x	x	x
36						x											x	x	x	x
37																x	x	x	x	x
38																x	x	x	x	x
39			**x**	**x**	**x**	x	x													
40																x	x	x	x	x
41																x	x	x	x	x
42													**x**			x	x		x	x
44																x	x	x	x	x
45																x	x	x	x	x
46			**x**	**x**	**x**	x	x													
47																x	x	x	x	x
49													**x**			x	x		x	x
51	**x**						x	x						**x**	**x**					
52													**x**	**x**	**x**	x	x			
53	**x**	**x**	**x**	**x**	**x**															
54	**x**	**x**	**x**	**x**	**x**															
55				**x**	**x**		x	x			**x**									

12 months (continued)																				
Performance Level																				
%	0-24					25-49					50-74					75-100				
56						x	x	x						**x**	**x**					

Appendix Y: Number (%) of children in each experience group performing each oral-motor skill (OMS) across all textures. Note that bolded items were performed at mastery level (performance by 75% or more of children within the group).

Experience	Least	Average		Most	
OMS	Number (%)	OMS	Number (%)	OMS	Number (%)
1	32/58 (55.17%)	1	102/157 (64.97%)	1	27/40 (67.50%)
2	**56/58 (96.55%)**	2	**155/157 (98.73%)**	2	**40/40 (100%)**
3	**55/58 (94.83%)**	3	**140/157 (89.17%)**	3	**36/40 (90%)**
4	20/58 (34.48%)	4	68/157 (43.31%)	4	16/40 (40%)
5	23/58 (39.66%)	5	76/157 (48.41%)	5	14/40 (35%)
6	**56/58 (96.55%)**	6	**153/157 (97.45%)**	6	**39/40 (97.50%)**
7	**55/58 (94.83%)**	7	**157/157 (100%)**	7	**39/40 (97.50%)**
8	**55/55 (100%)**	8	**131/133 (98.50%)**	8	**33/33 (100%)**
9	**52/58 (89.66%)**	9	**154/156 (98.72%)**	9	**39/40 (97.50%)**
10	**54/58 (93.10%)**	10	**148/155 (95.48%)**	10	**39/40 (97.50%)**
11	**47/58 (81.03%)**	11	114/155 (73.55%)	11	27/39 (69.23%)
12	**54/54 (100%)**	12	**125/137 (91.24%)**	12	**33/36 (91.67%)**
13	**51/58 (87.93%)**	13	**143/156 (91.67%)**	13	**36/39 (92.31%)**
14	**49/56 (87.50%)**	14	**136/147 (92.52%)**	14	**35/39 (89.74%)**
15	**48/56 (85.71%)**	15	**134/147 (91.16%)**	15	**35/39 (89.74%)**
16	**5/5 (100%)**	16	3/5 (60%)	16	0/1 (0%)
17	**38/39 (97.44%)**	17	**85/91 (93.41%)**	17	**28/28 (100%)**
18	**47/47 (100%)**	18	**124/124 (100%)**	18	**34/34 (100%)**

Experience OMS	Least Number (%)	Average OMS	Number (%)	Most OMS	Number (%)
19	**45/58 (77.59%)**	19	114/157 (72.61%)	19	**35/40 (87.50%)**
20	41/58 (70.69%)	20	105/157 (66.88%)	20	20/40 (50%)
21	24/38 (63.16%)	21	46/91 (50.55%)	21	16/28 (57.14%)
22	**57/57 (100%)**	22	**157/157 (100%)**	22	**40/40 (100%)**
24	4/6 (66.67%)	24	**20/26 (76.92%)**	24	**5/5 (100%)**
25	**8/8 (100%)**	25	**33/33 (100%)**	25	**6/6 (100%)**
26	3/8 (37.50%)	26	5/33 (15.15%)	26	2/6 (33.33%)
27	3/8 (37.50%)	27	4/33 (12.12%)	27	1/6 (16.67%)
28	**7/8 (87.50%)**	28	**33/33 (100%)**	28	**6/6 (100%)**
29	**7/8 (87.50%)**	29	**30/33 (90.91%)**	29	**6/6 (100%)**
30	3/8 (37.50%)	30	23/33(69.70%)	30	3/6 (50%)
31	15/26 (57.69%)	31	37/62 (59.68%)	31	10/18 (55.56%)
32	11/19 (57.89%)	32	37/58 (63.79%)	32	8/17 (47.06%)
33	**57/57 (100%)**	33	**149/154 (96.75%)**	33	**37/38 (97.37%)**
34	**50/57 (87.72%)**	34	**124/154 (80.52%)**	34	**29/38 (76.32%)**
35	**50/57 (87.72%)**	35	**134/154 (87.01%)**	35	**31/38 (81.58%)**
36	**45/56 (80.36%)**	36	108/148 (72.97%)	36	**28/37 (75.68%)**
37	**43/48 (89.58%)**	37	**129/134 (96.27%)**	37	**31/33 (93.94%)**
38	**53/57 (92.98%)**	38	**146/154 (94.81%)**	38	**37/38 (97.37%)**
39	13/57 (22.81%)	39	29/154 (18.83%)	39	7/38 (18.42%)
40	**52/57 (91.23%)**	40	**142/154 (92.21%)**	40	**36/38 (94.74%)**

Experience OMS	Least Number (%)	Average OMS	Number (%)	Most OMS	Number (%)
41	**56/57 (98.25%)**	41	**146/154 (94.81%)**	41	**37/38 (97.37%)**
42	**51/57 (89.47%)**	42	**129/153 (84.31%)**	42	**31/38 (81.58%)**
44	**56/57 (98.25%)**	44	**150/153 (98.04%)**	44	**36/38 (94.74%)**
45	**48/54 (88.89%)**	45	**145/149 (97.32%)**	45	**36/37 (97.30%)**
46	13/54 (24.07%)	46	38/149 (25.50%)	46	10/37 (27.03%)
47	**52/54 (96.30%)**	47	**144/149 (96.64%)**	47	**36/37 (97.30%)**
49	**48/54 (88.89%)**	49	**121/149 (81.21%)**	49	**30/37 (81.08%)**
51	8/40 (20%)	51	39/110 (35.45%)	51	7/26 (26.92%)
52	29/40 (72.50%)	52	**92/110 (83.64%)**	52	**21/26 (80.77%)**
53	0/40 (0%)	53	2/110 (1.82%)	53	0/26 (0%)
54	0/40 (0%)	54	4/110 (3.64%)	54	0/26 (0%)
55	8/40 (20%)	55	33/110 (30%)	55	10/26 (38.46%)
56	13/40 (32.50%)	56	47/110 (42.73%)	56	6/26 (23.08%)

Appendix Z: Inferential statistics for experience contrasts for each oral-motor skill (OMS) across all textures. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	Least vs. Average	-.098	213	.075	1.315	.190
	Average vs. Most	-.025	195	.085	-.299	.765
	Least vs. Most	-.123	96	.101	-1.222	.225
OMS2	Least vs. Average	-.022	213	.021	1.045	.297
	Average vs. Most	-.013	195	.018	-.715	.476
	Least vs. Most	-.034	96	.029	-1.183	.240
OMS3	Least vs. Average	.057	213	.045	-1.266	.207
	Average vs. Most	-.008	195	.055	-.151	.880
	Least vs. Most	.048	96	.053	.907	.367
OMS4	Least vs. Average	-.088	213	.076	1.167	.245
	Average vs. Most	.033	195	.088	.376	.707
	Least vs. Most	-.055	96	.100	-.552	.582
OMS5	Least vs. Average	-.088	213	.077	1.141	.255
	Average vs. Most	.134	195	.088	1.521	.130
	Least vs. Most	.047	96	.101	.463	.644
OMS6	Least vs. Average	-.009	213	.025	.354	.723
	Average vs. Most	.000	195	.028	-.017	.986
	Least vs. Most	-.009	96	.036	-.265	.791
OMS7	Least vs. Average	-.052	213	.018	2.913	.004*
	Average vs. Most	.025	195	.013	1.996	.047*
	Least vs. Most	-.027	96	.041	-.652	.516
OMS8	Least vs. Average	.015	186	.016	-.911	.363
	Average vs. Most	-.015	164	.021	-.706	.481
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS9	Least vs. Average	-.091	212	.029	3.164	.002*
	Average vs. Most	.012	194	.022	.557	.578
	Least vs. Most	-.078	96	.053	-1.484	.141
OMS10	Least vs. Average	-.024	211	.034	.696	.487
	Average vs. Most	-.020	193	.035	-.571	.569
	Least vs. Most	-.044	96	.045	-.967	.336

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS11	Least vs. Average	.075	211	.066	-1.130	.260
	Average vs. Most	.043	192	.080	.538	.591
	Least vs. Most	.118	95	.088	1.339	.184
OMS12	Least vs. Average	.088	189	.039	-2.265	.025*
	Average vs. Most	-.004	171	.053	-.080	.936
	Least vs. Most	.083	88	.038	2.191	.031*
OMS13	Least vs. Average	-.037	212	.045	.832	.406
	Average vs. Most	-.006	193	.049	-.130	.897
	Least vs. Most	-.044	95	.063	-.690	.492
OMS14	Least vs. Average	-.050	201	.045	1.122	.263
	Average vs. Most	.028	184	.049	.563	.574
	Least vs. Most	-.022	93	.067	-.333	.740
OMS15	Least vs. Average	-.048	201	.049	.973	.332
	Average vs. Most	.007	184	.054	.137	.891
	Least vs. Most	-.040	93	.070	-.576	.566
OMS16	Least vs. Average	.500	9	.247	-2.023	.074
	Average vs. Most	.500	5	.592	.845	.437
	Least vs. Most	1.000	4	.000	.	.
OMS17	Least vs. Average	.051	128	.046	-1.112	.268
	Average vs. Most	-.077	117	.051	-1.515	.133
	Least vs. Most	-.026	65	.030	-.845	.401
OMS18	Least vs. Average	-.008	169	.013	-.615	.540
	Average vs. Most	-.008	156	.015	-.522	.602
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS19	Least vs. Average	.050	213	.068	-.735	.463
	Average vs. Most	-.149	195	.076	-1.967	.051
	Least vs. Most	-.099	96	.080	-1.243	.217
OMS20	Least vs. Average	.044	213	.072	-.615	.539
	Average vs. Most	.162	195	.085	1.907	.058
	Least vs. Most	.207	96	.098	2.102	.038*
OMS21	Least vs. Average	.137	127	.096	-1.423	.157
	Average vs. Most	-.077	117	.109	-.708	.481
	Least vs. Most	.060	64	.123	.488	.627

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS22	Least vs. Average	.006	212	.011	-.602	.548
	Average vs. Most	-.006	195	.013	-.504	.615
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS24	Least vs. Average	-.074	31	.207	.358	.723
	Average vs. Most	-.259	30	.202	-1.281	.210
	Least vs. Most	-.333	9	.233	-1.430	.186
OMS25	Least vs. Average	.029	40	.061	-.480	.633
	Average vs. Most	-.029	38	.071	-.416	.680
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS26	Least vs. Average	.228	40	.154	-1.481	.147
	Average vs. Most	-.186	38	.170	-1.096	.280
	Least vs. Most	.042	12	.279	.149	.884
OMS27	Least vs. Average	.257	40	.144	-1.782	.082
	Average vs. Most	-.049	38	.150	-.327	.746
	Least vs. Most	.208	12	.257	.812	.433
OMS28	Least vs. Average	-.096	40	.084	1.132	.264
	Average vs. Most	-.029	38	.071	-.416	.680
	Least vs. Most	-.125	12	.146	-.857	.408
OMS29	Least vs. Average	-.007	40	.130	.056	.955
	Average vs. Most	-.118	38	.135	-.872	.389
	Least vs. Most	-.125	12	.146	-.857	.408
OMS30	Least vs. Average	-.301	40	.190	1.590	.120
	Average vs. Most	.176	38	.215	.822	.416
	Least vs. Most	-.125	12	.286	-.436	.670
OMS31	Least vs. Average	-.010	87	.116	.089	.929
	Average vs. Most	.032	79	.134	.238	.813
	Least vs. Most	.021	42	.155	.137	.891
OMS32	Least vs. Average	-.048	76	.130	.371	.712
	Average vs. Most	.157	74	.136	1.152	.253
	Least vs. Most	.108	34	.170	.636	.529
OMS33	Least vs. Average	.039	209	.026	-1.513	.132
	Average vs. Most	-.013	190	.034	-.371	.711
	Least vs. Most	.026	93	.021	1.228	.223

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS34	Least vs. Average	.078	209	.060	-1.317	.189
	Average vs. Most	.036	190	.074	.481	.631
	Least vs. Most	.114	93	.078	1.456	.149
OMS35	Least vs. Average	.014	209	.053	-.257	.798
	Average vs. Most	.048	190	.064	.746	.457
	Least vs. Most	.061	93	.075	.821	.414
OMS36	Least vs. Average	.081	202	.068	-1.177	.241
	Average vs. Most	-.034	183	.082	-.412	.681
	Least vs. Most	.047	91	.088	.533	.595
OMS37	Least vs. Average	-.059	180	.040	1.482	.140
	Average vs. Most	.016	165	.042	.379	.705
	Least vs. Most	-.044	79	.064	-.679	.499
OMS38	Least vs. Average	-.012	209	.037	.313	.754
	Average vs. Most	-.032	190	.040	-.795	.427
	Least vs. Most	-.044	93	.047	-.932	.354
OMS39	Least vs. Average	.040	209	.062	-.640	.523
	Average vs. Most	.004	190	.071	.058	.954
	Least vs. Most	.044	93	.086	.509	.612
OMS40	Least vs. Average	-.003	209	.044	.076	.940
	Average vs. Most	-.032	190	.049	-.651	.516
	Least vs. Most	-.035	93	.055	-.636	.526
OMS41	Least vs. Average	.041	209	.033	-1.240	.216
	Average vs. Most	-.032	190	.040	-.795	.427
	Least vs. Most	.009	93	.030	.289	.773
OMS42	Least vs. Average	.058	208	.055	-1.054	.293
	Average vs. Most	.021	189	.068	.306	.760
	Least vs. Most	.079	93	.072	1.092	.278
OMS44	Least vs. Average	.009	208	.024	-.362	.718
	Average vs. Most	.026	189	.032	.835	.405
	Least vs. Most	.035	93	.037	.953	.343
OMS45	Least vs. Average	-.078	201	.036	2.171	.031*
	Average vs. Most	-.007	184	.033	-.200	.842
	Least vs. Most	-.084	89	.057	-1.480	.142

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS46	Least vs. Average	-.014	201	.069	.206	.837
	Average vs. Most	-.015	184	.081	-.189	.851
	Least vs. Most	-.030	89	.094	-.315	.753
OMS47	Least vs. Average	.003	201	.031	-.104	.917
	Average vs. Most	-.013	184	.035	-.377	.707
	Least vs. Most	-.010	89	.039	-.260	.796
OMS49	Least vs. Average	.084	201	.060	-1.392	.166
	Average vs. Most	-.005	184	.073	-.075	.941
	Least vs. Most	.078	89	.075	1.040	.301
OMS51	Least vs. Average	-.155	148	.085	1.812	.072
	Average vs. Most	.085	134	.104	.823	.412
	Least vs. Most	-.069	64	.107	-.648	.519
OMS52	Least vs. Average	-.102	148	.074	1.384	.168
	Average vs. Most	.020	134	.084	.234	.815
	Least vs. Most	-.083	64	.109	-.758	.451
OMS53	Least vs. Average	-.018	148	.021	.855	.394
	Average vs. Most	.018	134	.026	.689	.492
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS54	Least vs. Average	-.036	148	.030	1.220	.224
	Average vs. Most	.036	134	.037	.983	.327
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS55	Least vs. Average	-.100	148	.082	1.213	.227
	Average vs. Most	-.085	134	.102	-.830	.408
	Least vs. Most	-.185	64	.112	-1.655	.103
OMS56	Least vs. Average	-.102	148	.091	1.128	.261
	Average vs. Most	.197	134	.106	1.858	.065
	Least vs. Most	.094	64	.115	.818	.417

Appendix AA: Number (%) of children in the least experienced group (least exp) performing each oral-motor skill (OMS) for each texture. Note that bolded items were performed at mastery level (performance by 75% or more of children within the group). N/A denotes a skill not relevant to texture.

Least exp OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
1	4/11 (36.36%)	5/12 (41.67%)	10/16 (62.50%)	**9/11 (81.82%**	4/8 (50%)
2	**11/11 (100%)**	**11/12 (91.67%)**	**16/16 (100%)**	**11/11 (100%)**	**7/8 (87.50%)**
3	**10/11 (90.91%)**	**11/12 (91.67%)**	**15/16 (93.75%)**	**11/11 (100%)**	**8/8 (100%)**
4	1/11 (9.09%)	4/12 (33.33%)	6/16 (37.50%)	6/11 (54.55%)	3/8 (37.50%)
5	3/11 (27.27%)	2/12 (16.67%)	2/16 (12.50%)	**10/11 (90.91%)**	**6/8 (75%)**
6	**10/11 (90.91%)**	**11/12 (91.67%)**	**16/16 (100%)**	**11/11 (100%)**	**8/8 (100%)**
7	**11/11 (100%)**	**11/12 (91.67%)**	**16/16 (100%)**	**10/11 (90.91%)**	**7/8 (87.50%)**
8	**11/11 (100%)**	**12/12 (100%)**	**16/16 (100%)**	**9/9 (100%)**	**7/7 (100%)**
9	**10/11 (90.91%)**	**11/12 (91.67%)**	**14/16 (87.50%)**	**9/11 (81.82%)**	**8/8 (100%)**
10	11**/11 (100%)**	**10/12 (83.33%)**	**15/16 (93.75%)**	**10/11 (90.91%)**	**8/8 (100%)**
11	7/11 (63.64%)	7/12 (58.33%)	**16/16 (100%)**	**9/11 (81.82%)**	**8/8 (100%)**
12	**11/11 (100%)**	**12/12 (100%)**	**16/16 (100%)**	**9/9 (100%)**	**6/6 (100%)**
13	**11/11 (100%)**	**12/12 (100%)**	**15/16 (93.75%)**	**7**/11 (63.64%)	**6/8 (75%)**
14	**11/11 (100%)**	**12/12 (100%)**	**16/16 (100%)**	6/11 (54.55%)	4/6 (66.67%)
15	**11/11 (100%)**	**12/12 (100%)**	**15/16 (93.75%)**	6/11 (54.55%)	4/6 (66.67%)
16	**1/1 (100%)**	**2/2 (100%)**	**2/2 (100%)**	n/a	n/a
17	**11/11 (100%)**	**12/12 (100%)**	**15/16 (93.75%)**	n/a	n/a
18	**11/11 (100%)**	**12/12 (100%**	**16/16 (100%)**	n/a	**8/8 (100%)**

Least exp OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
19	5/11 (45.45%)	5/12 (41.67%)	**16/16 (100%)**	**11/11 (100%)**	**8/8 (100%)**
20	8/11 (72.73%)	**10/12 (83.33%)**	10/16(62.50%)	6/11 (54.55%)	**7/8 (87.50%)**
21	5/11 (45.45%)	4/11 (36.36%)	**15/16 (93.75%)**	n/a	n/a
22	**11/11 (100%)**	**12/12 (100%)**	**16/16 (100%)**	**11/11 (100%**	**7/7 (100%)**
24	n/a	n/a	n/a	n/a	4/6 (66.67%)
25	n/a	n/a	n/a	n/a	**8/8 (100%)**
26	n/a	n/a	n/a	n/a	3/8 (37.50%)
27	n/a	n/a	n/a	n/a	3/8 (37.50%)
28	n/a	n/a	n/a	n/a	**7/8 (87.50%)**
29	n/a	n/a	n/a	n/a	**7/8 (87.50%)**
30	n/a	n/a	n/a	n/a	3/8 (37.50%)
31	n/a	1/7 (14.29%)	3/5 (60%)	**8/9 (88.89%)**	3/5 (60%)
32	n/a	0/6 (0%)	2/3 (66.67%)	**6/6 (100%)**	**3/4 (75%)**
33	**11/11 (100%)**	**12/12 (100%)**	**16/16 (100%)**	**11/11 (100%)**	**7/7 (100%)**
34	**9/11 (81.82%)**	**9/12 (75%)**	**14/16 (87.50%)**	**11/11 (100%)**	**7/7 (100%)**
35	**9/11 (81.82%)**	**12/12 (100%)**	**13/16 (81.25%)**	**11/11 (100%)**	5/7 (71.43%)
36	8/11 (72.73%)	**9/12 (75%)**	**14/16 (87.50%)**	**9/11 (81.82%)**	**5/6 (83.33%)**
37	5**/6 (83.33%)**	**8/10 (80%)**	**13/14 (92.86%)**	**10/11 (90.91%)**	**7/7 (100%)**
38	**11/11 (100%)**	**11/12 (91.67%)**	**15/16 (93.75%)**	**911 (81.82%)**	**7/7 (100%)**
39	6/11 (54.55%)	6/12 (50%)	1/16 (6.25%)	0/11 (0%)	0/7 (0%)
40	8/11 (72.73%)	**10/12 (83.33%)**	**16/16 (100%)**	**11/11 (100%)**	**7/7 (100%)**

Least exp OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
41	**11/11 (100%)**	**12/12 (100%)**	**16/16 (100%)**	**10/11 (90.91%)**	**7/7 (100%)**
42	**11/11 (100%)**	**11/12 (91.67%)**	**13/16 (81.25%)**	**10/11 (90.91%)**	**6/7 (85.71%)**
44	**11/11 (100%)**	**12/12 (100%)**	**16/16 (100%)**	**10/11 (90.91%)**	**7/7 (100%)**
45	**11/11 (100%)**	**10/12 (83.33%)**	**13/14 (92.86%)**	**9/11 (81.82%)**	**5/6 (83.33%)**
46	6/11 (54.55%)	5/12 (41.67%)	2/14 (14.29%)	0/11 (0%)	0/6 (0%)
47	**11/11 (100%)**	**12/12 (100%)**	**14/14 (100%)**	**10/11 (90.91%)**	**5/6 (83.33%)**
49	**10/11 (90.91%)**	**10/12 (83.33%)**	**12/14 (85.71%)**	**10/11 (90.91%)**	**6/6 (100%)**
51	0/11 (0%)	2/11 (18.18%)	2/10 (20%)	**3/4 (75%)**	1/4 (25%)
52	**9/11 (81.82%)**	**9/11 (81.82%)**	5/10 (50%)	**3/4 (75%)**	**3/4 (75%)**
53	0/11 (0%)	0/11 (0%)	0/10 (0%)	0/4 (0%)	0/4 (0%)
54	0/11 (0%)	0/11 (0%)	0/10 (0%)	0/4 (0%)	0/4 (0%)
55	2/11 (18.18%)	6/11 (54.55%)	0/10 (0%)	0/4 (0%)	0/4 (0%)
56	1/11 (9.09%)	2/11(18.18%)	4/10 (40%)	**4/4 (100%)**	2/4 (50%)

Appendix BB: Number (%) of children in the average experienced group (average exp) performing each oral-motor skill (OMS) for each texture. Note that bolded items were performed at mastery level (performance by 75% or more of children within the group). N/A denotes a skill not relevant to texture.

Average exp OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
1	18/35 (51.43%)	21/29 (72.41%)	16/27 (59.26%)	24/33 (72.73%)	23/33 (69.70%)
2	**34/35 (97.14%)**	**29/29 (100%)**	**26/27 (96.30%)**	**33/33 (100%)**	**33/33 (100%)**
3	**30/35 (85.71%)**	**22/29 (75.86%)**	**26/27 (96.30%)**	**32/33 (96.97%)**	**30/33 (90.91%)**
4	11/35 (31.43%)	13/29 (44.83%)	12/27 (44.44%)	17/33 (51.52%)	15 /33 (45.45%)
5	0/35 (0%)	5/29 (17.24%)	8/27 (29.63%)	**30/33 (90.91%)**	**33/33 (100%)**
6	**35/35 (100%)**	**28/29 (96.55%)**	**26/27 (96.30%)**	**32/33 (96.97%)**	**32/33 (96.97%)**
7	**35/35 (100%)**	**29 /29 (100%)**	**27/27 (100%)**	**33/33 (100%)**	**33/33 (100%)**
8	**34/35 (97.14%)**	**29/29 (100%)**	**26/27 (96.30%)**	**20/20 (100%)**	**22/22 (100%)**
9	**35/35 (100%)**	**29/29 (100%)**	**27/27 (100%)**	**31/32 (96.88%)**	**32/33 (96.97%)**
10	**31/35 (88.57%)**	**27/29 (93.10%)**	**26/27 (96.30%)**	**31/31 (100%)**	**33/33 (100%)**
11	12/35 (34.29%)	20/29 (68.97%)	**22/27 (81.48%)**	**27/31 (87.10%)**	**33/33 (100%)**
12	**33/35 (94.29%)**	**28/29 (96.55%)**	**24/27 (88.89%)**	**21/23 (91.30%)**	**19/23 (82.61%)**
13	**35/35 (100%)**	**29/29 (100%)**	**26/27 (96.30%)**	**25/32 (78.13%)**	**28/33 (84.85%)**
14	**35/35 (100%)**	**29/29 (100%)**	**26/27 (96.30%)**	**25/32 (78.13%)**	**21/24 (87.50%)**
15	**35/35 (100%)**	**29/29 (100%)**	**25/27 (92.59%)**	**25/32 (78.13%)**	**20/24 (83.33%)**
16	n/a	1/1 (100%)	2/4 (50%)	n/a	n/a
17	**34/35 (97.14%)**	**28/29 (96.55%)**	**23/27 (85.19%)**	n/a	n/a
18	**35/35 (100%)**	**29/29 (100%)**	**27/27 (100%)**	n/a	**33/33 (100%)**

Average exp OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
19	14/35 (40%)	15/29 (51.72%)	**23/27 (85.19%)**	**33/33 (100%)**	**29/33 (87.88%)**
20	25/35 (71.43%)	18/29 (62.07%)	16/27 (59.26%)	21/33 (63.64%)	**25/33 (75.76%)**
21	9/35 (25.71%)	13/29 (44.83%)	**24/27 (88.89%)**	n/a	n/a
22	**35/35 (100%)**	**29/29 (100%)**	**27/27 (100%)**	**33/33 (100%)**	**33/33 (100%)**
24	n/a	n/a	n/a	n/a	**20/26 (76.92%)**
25	n/a	n/a	n/a	n/a	**33/33 (100%)**
26	n/a	n/a	n/a	n/a	5/33 (15.15%)
27	n/a	n/a	n/a	n/a	4/33 (12.12%)
28	n/a	n/a	n/a	n/a	**33/33 (100%)**
29	n/a	n/a	n/a	n/a	**30/33 (90.91%)**
30	n/a	n/a	n/a	n/a	23/33 (69.70%)
31	n/a	3/13 (23.08%)	9/13 (69.23%)	**15/17 (88.24%)**	10/19 (52.63%)
32	n/a	1/12 (8.33%)	7/11 (63.64%)	**1617 (94.12%)**	13/18 (72.22%)
33	**35/35 (100%)**	**28/29 (96.55%)**	**25/27 (92.59%)**	**32/33 (96.97%)**	**29/30 (96.67%)**
34	1935 (54.29%)	**22/29 (75.86%)**	**24/27 (88.89%)**	**29/33 (87.88%)**	**30/30 (100%)**
35	**29/35 (82.86%)**	**24/29 (82.76%)**	**24/27 (88.89%)**	**31/33 (93.94%)**	**26/30 (86.67%)**
36	14/33 (42.42%)	19/28 (67.86%)	**22/27 (81.48%)**	**29/32(90.63%)**	**24/28 (85.71%)**
37	**22/25 (88.00%)**	**22/24 (91.67%)**	**26/26 (100%)**	**31/31 (100%)**	**28/28 (100%)**
38	**34/35 (97.14%)**	**27/29 (93.10%)**	**25/27 (92.59%)**	**30/33 (90.91%)**	**30/30 (100%)**
39	13/35 (37.14%)	10/29 (34.48%)	1/27 (3.70%)	2/33 (6.06%)	3/30 (10%)
40	**29/35 (82.86%)**	**26/29 (89.66%)**	**26/27 (96.30%)**	**33/33 (100%)**	**28/30 (93.33%)**

Average exp OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
41	**35/35 (100%)**	**27/29 (93.10%)**	**24/27 (88.89%)**	**31/33 (93.94%)**	**29/30 (96.67%)**
42	**32/35 (91.43%)**	**26/29 (89.66%)**	18/27 (66.67%)	**26/33 (78.79%)**	**27/29 (93.10%)**
44	**33/35 (94.29%)**	**29/29 (100%)**	**26/27 (96.30%)**	**33/33 (100%)**	**29/29 (100%)**
45	**35/35 (100%)**	**28/29 (96.55%)**	**23/25 (92%)**	**31/32 (96.88%)**	**28/28 (100%)**
46	14/35 (40%)	11/29 (37.93%)	1/25 (4%)	6/32 (18.75%)	6/28 (21.43%)
47	**35/35 (100%)**	**27/29 (93.10%)**	**23/25 (92%)**	**31/32 (96.88%)**	**28/28 (100%)**
49	**32/35 (91.43%)**	**26/29 (89.66%)**	15/25 (60%)	**25/32 (78.13%)**	**23/28 (82.14%)**
51	1/33 (3.03%)	9/27 (33.33%)	6/14 (42.86%)	9/16 (56.25%)	14/20 (70%)
52	**29/33 (87.88%)**	**23/27 (85.19%)**	**12/14 (85.71%)**	**13/16 (81.25%)**	**15/20 (75%)**
53	1/33 (3.03%)	1/27 (3.70%)	0/14 (0%)	0/16 (0%)	0/20 (0%)
54	1/33 (3.03%)	1/27 (3.70%)	0/14 (0%)	0/16 (0%)	2/20 (10%)
55	15/33 (45.45%)	9/27 (33.33%)	5/14 (35.71%)	2/16 (12.50%)	2/20 (10%)
56	9/33 (27.27%)	8/27 (29.63%)	7/14 (50%)	**12/16 (75%)**	11/20 (55%)

Appendix CC: Number (%) of children in the most experienced group (most exp) performing each oral-motor skill (OMS) for each texture. Note that bolded items were performed at mastery level (performance by 75% or more of children within the group). N/A denotes a skill not relevant to texture.

Most exp OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
1	9/14 (64.29%)	7/10 (70.00%)	**3/4 (75%)**	**5/6 (83.33%)**	3/6 (50%)
2	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	**6/6 (100%)**	**6/6 (100%)**
3	**13/14 (92.86%)**	**8/10 (80%)**	**4/4 (100%)**	**5/6 (83.33%)**	**6/6 (100%)**
4	6/14 (42.86%)	2/10(20%)	**3/4 (75%)**	2/6 (33.33%)	3/6 (50%)
5	1/14(7.14%)	0/10 (0%)	1/4 (25%)	**6/6(100%)**	**6/6 (100%)**
6	**13/14 (92.86%)**	**10/10 (100%)**	**4/4 (100%)**	**6/6 (100%)**	**6/6 (100%)**
7	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	**5/6 (83.33%)**	**6/6 (100%)**
8	**13/13 (100%)**	**10/10 (100%)**	**4/4 (100%)**	**2/2 (100%)**	**4/4 (100%)**
9	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	**5/6 (83.33%)**	**6/6 (100%)**
10	**13/14 (92.86%)**	**10/10 (100%)**	**4/4 (100%)**	**6/6 (100%)**	**6/6 (100%)**
11	7/14 (50%)	5/10 (50%)	**4/4 (100%)**	**6/6 (100%)**	**5/5 (100%)**
12	**11/14 (78.57%)**	**10/10 (100%)**	**4/4 (100%)**	**4/4 (100%)**	**4/4 (100%)**
13	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	3/6 (50%)	**5/5 (100%)**
14	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	2/6 (33.33%)	**5/5 (100%)**
15	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	2/6 (33.33%)	**5/5 (100%)**
16	n/a	n/a	0/1 (0%)	n/a	n/a
17	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	n/a	n/a
18	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	n/a	**6/6 (100%)**

Most exp OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
19	10/14 (71.43%)	**9/10 (90%)**	**4/4 (100%)**	**6/6 (100%)**	**6/6 (100%)**
20	6/14 (42.86%)	5 /10 (50%)	1/4 (25%)	4/6 (66.67%)	4/6 (66.67%)
21	7/14 (50%)	5 /10 (50%)	**4/4 (100%)**	n/a	n/a
22	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	**6/6 (100%)**	**6/6 (100%)**
24	n/a	n/a	n/a	n/a	**5/5 (100%)**
25	n/a	n/a	n/a	n/a	**6/6 (100%)**
26	n/a	n/a	n/a	n/a	2/6 (33.33%)
27	n/a	n/a	n/a	n/a	1/6 (16.67%)
28	n/a	n/a	n/a	n/a	**6/6 (100%)**
29	n/a	n/a	n/a	n/a	**6/6 (100%)**
30	n/a	n/a	n/a	n/a	3/6 (50%)
31	n/a	1/7 (14.29%)	**2/2 (100%)**	**4/5 (80%)**	**3/4 (75%)**
32	n/a	1/7 (14.29%)	1/2 (50%)	**3/4 (75%)**	**3/4 (75%)**
33	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	**5/6 (83.33%)**	**4/4 (100%)**
34	10/14 (71.43%)	7/10 (70%)	**4/4 (100%)**	**5/6 (83.33%)**	**3/4 (75%)**
35	**11/14 (78.57%)**	7/10 (70%)	**3/4 (75%)**	**6/6 (100%)**	**4/4 (100%)**
36	7/13 (53.85%)	**8/10 (80%)**	**4/4 (100%)**	**5/6 (83.33%)**	**4/4 (100%)**
37	**10/11 (90.91%)**	**9/10 (90%)**	**2/2 (100%)**	**6/6 (100%)**	**4/4 (100%)**
38	**14/14 (100%)**	**10/10 (100%)**	**3 /4 (75%)**	**6/6 (100%)**	**4/4 (100%)**
39	5/14 (35.71%)	0/10 (0%)	1/4 (25%)	0/6 (0%)	1/4 (25%)
40	**12/14 (85.71%)**	**10/10 (100%)**	**4/4 (100%)**	**6/6 (100%)**	**4/4 (100%)**

Most exp OMS	Smooth Puree Number (%)	Textured Puree Number (%)	Solids Number (%)	Cracker Piece Number (%)	Cracker Whole Number (%)
41	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	**5/6 (83.33%)**	**4/4 (100%)**
42	**12/14 (85.71%)**	7/10 (70%)	**4/4 (100%)**	4/6 (66.67%)	**4/4 (100%)**
44	**13/14 (92.86%)**	**10/10 (100%)**	**4/4 (100%)**	**5/6 (83.33%)**	**4/4 (100%)**
45	**14/14 (100%)**	**10/10 (100%)**	**3/4 (75%)**	**5/5 (100%)**	**4/4 (100%)**
46	6/14 (42.86%)	1/10 (10%)	2/4 (50%)	1/5 (20%)	0/4 (0%)
47	**14/14 (100%)**	**10/10 (100%)**	**4/4 (100%)**	**5/5 (100%)**	**3/4 (75%)**
49	**12/14 (85.71%)**	6/10 (60%)	**4/4 (100%)**	**4/5 (80%)**	**4/4 (100%)**
51	3/12 (25%)	3/9 (33.33%)	n/a	0/2 (0%)	1/3 (33.33%)
52	**11/12 (91.67%)**	**8/9 (88.89%)**	n/a	1/2 (50%)	1/3 (33.33%)
53	0/12 (0%)	0/9 (0%)	n/a	0/2 (0%)	0/3 (0%)
54	0/12 (0%)	0/9 (0%)	n/a	0/2 (0%)	0/3 (0%)
55	7/12 (58.33%)	3/9 (33.33%)	n/a	0/2 (0%)	0/3 (0%)
56	3/12 (25%)	1/9 (11.11%)	n/a	1/2 (50%)	1/3 (33.33%)

Appendix DD: Inferential statistics for experience contrasts for each oral-motor skill (OMS) within smooth puree textures. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	Least vs. Average	-.151	44	.175	.860	.394
	Average vs. Most	.025	195	.085	-.299	.765
	Least vs. Most	.123	96	.101	-1.222	.225
OMS2	Least vs. Average	.029	44	.051	-.556	.581
	Average vs. Most	.013	195	.018	-.715	.476
	Least vs. Most	.034	96	.029	-1.183	.240
OMS3	Least vs. Average	.052	44	.119	-.437	.664
	Average vs. Most	.008	195	.055	-.151	.880
	Least vs. Most	-.048	96	.053	.907	.367
OMS4	Least vs. Average	-.223	44	.151	1.474	.147
	Average vs. Most	-.033	195	.088	.376	.707
	Least vs. Most	.055	96	.100	-.552	.582
OMS5	Least vs. Average	.273	44	.077	-3.543	.001*
	Average vs. Most	-.134	195	.088	1.521	.130
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS6	Least vs. Average	-.091	44	.050	1.830	.074
	Average vs. Most	.000	195	.028	-.017	.986
	Least vs. Most	.009	96	.036	-.265	.791
OMS7	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	-.025	195	.013	1.996	.047*
	Least vs. Most	.027	96	.041	-.652	.516
OMS8	Least vs. Average	.029	44	.051	-.556	.581
	Average vs. Most	.015	164	.021	-.706	.481
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS9	Least vs. Average	-.091	44	.050	1.830	.074
	Average vs. Most	-.012	194	.022	.557	.578
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS10	Least vs. Average	.114	44	.098	-1.165	.250
	Average vs. Most	.020	193	.035	-.571	.569
	Least vs. Most	.044	96	.045	-.967	.336

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS11	Least vs. Average	.294	44	.168	-1.744	.088
	Average vs. Most	-.043	192	.080	.538	.591
	Least vs. Most	-.118	95	.088	1.339	.184
OMS12	Least vs. Average	.057	44	.072	-.799	.429
	Average vs. Most	.004	171	.053	-.080	.936
	Least vs. Most	-.083	88	.038	2.191	.031*
OMS13	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.006	193	.049	-.130	.897
	Least vs. Most	.044	95	.063	-.690	.492
OMS14	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	-.028	184	.049	.563	.574
	Least vs. Most	.022	93	.067	-.333	.740
OMS15	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	-.007	184	.054	.137	.891
	Least vs. Most	.040	93	.070	-.576	.566
OMS16	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	-.500	5	.592	.845	.437
	Least vs. Most	-1.000	4	.000	n/a	n/a
OMS17	Least vs. Average	.029	44	.051	-.556	.581
	Average vs. Most	.077	117	.051	-1.515	.133
	Least vs. Most	.026	65	.030	-.845	.401
OMS18	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.008	156	.015	-.522	.602
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS19	Least vs. Average	.055	44	.174	-.314	.755
	Average vs. Most	.149	195	.076	-1.967	.051
	Least vs. Most	.099	96	.080	-1.243	.217
OMS20	Least vs. Average	.013	44	.159	-.082	.935
	Average vs. Most	-.162	195	.085	1.907	.058
	Least vs. Most	-.207	96	.098	2.102	.038*
OMS21	Least vs. Average	.197	44	.160	-1.235	.223
	Average vs. Most	.077	117	.109	-.708	.481
	Least vs. Most	-.060	64	.123	.488	.627

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS22	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.006	195	.013	-.504	.615
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS24	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.259	30	.202	-1.281	.210
	Least vs. Most	.333	9	.233	-1.430	.186
OMS25	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.029	38	.071	-.416	.680
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS26	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.186	38	.170	-1.096	.280
	Least vs. Most	-.042	12	.279	.149	.884
OMS27	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.049	38	.150	-.327	.746
	Least vs. Most	-.208	12	.257	.812	.433
OMS28	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.029	38	.071	-.416	.680
	Least vs. Most	.125	12	.146	-.857	.408
OMS29	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.118	38	.135	-.872	.389
	Least vs. Most	.125	12	.146	-.857	.408
OMS30	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	-.176	38	.215	.822	.416
	Least vs. Most	.125	12	.286	-.436	.670
OMS31	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	-.032	79	.134	.238	.813
	Least vs. Most	-.021	42	.155	.137	.891
OMS32	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	-.157	74	.136	1.152	.253
	Least vs. Most	-.108	34	.170	.636	.529
OMS33	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.013	190	.034	-.371	.711
	Least vs. Most	-.026	93	.021	1.228	.223

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS34	Least vs. Average	.275	44	.167	-1.645	.107
	Average vs. Most	-.036	190	.074	.481	.631
	Least vs. Most	-.114	93	.078	1.456	.149
OMS35	Least vs. Average	-.010	44	.134	.078	.939
	Average vs. Most	-.048	190	.064	.746	.457
	Least vs. Most	-.061	93	.075	.821	.414
OMS36	Least vs. Average	.303	42	.172	-1.763	.085
	Average vs. Most	.034	183	.082	-.412	.681
	Least vs. Most	-.047	91	.088	.533	.595
OMS37	Least vs. Average	-.047	29	.157	.297	.769
	Average vs. Most	-.016	165	.042	.379	.705
	Least vs. Most	.044	79	.064	-.679	.499
OMS38	Least vs. Average	.029	44	.051	-.556	.581
	Average vs. Most	.032	190	.040	-.795	.427
	Least vs. Most	.044	93	.047	-.932	.354
OMS39	Least vs. Average	.174	44	.172	-1.012	.317
	Average vs. Most	-.004	190	.071	.058	.954
	Least vs. Most	-.044	93	.086	.509	.612
OMS40	Least vs. Average	-.101	44	.139	.727	.471
	Average vs. Most	.032	190	.049	-.651	.516
	Least vs. Most	.035	93	.055	-.636	.526
OMS41	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.032	190	.040	-.795	.427
	Least vs. Most	-.009	93	.030	.289	.773
OMS42	Least vs. Average	.086	44	.086	-.993	.326
	Average vs. Most	-.021	189	.068	.306	.760
	Least vs. Most	-.079	93	.072	1.092	.278
OMS44	Least vs. Average	.057	44	.072	-.799	.429
	Average vs. Most	-.026	189	.032	.835	.405
	Least vs. Most	-.035	93	.037	.953	.343
OMS45	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.007	184	.033	-.200	.842
	Least vs. Most	.084	89	.057	-1.480	.142

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS46	Least vs. Average	.145	44	.174	-.837	.407
	Average vs. Most	.015	184	.081	-.189	.851
	Least vs. Most	.030	89	.094	-.315	.753
OMS47	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.013	184	.035	-.377	.707
	Least vs. Most	.010	89	.039	-.260	.796
OMS49	Least vs. Average	-.005	44	.100	.052	.959
	Average vs. Most	.005	184	.073	-.075	.941
	Least vs. Most	-.078	89	.075	1.040	.301
OMS51	Least vs. Average	-.030	42	.053	.573	.570
	Average vs. Most	-.085	134	.104	.823	.412
	Least vs. Most	.069	64	.107	-.648	.519
OMS52	Least vs. Average	-.061	42	.122	.497	.622
	Average vs. Most	-.020	134	.084	.234	.815
	Least vs. Most	.083	64	.109	-.758	.451
OMS53	Least vs. Average	-.030	42	.053	.573	.570
	Average vs. Most	-.018	134	.026	.689	.492
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS54	Least vs. Average	-.030	42	.053	.573	.570
	Average vs. Most	-.036	134	.037	.983	.327
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS55	Least vs. Average	-.273	42	.168	1.620	.113
	Average vs. Most	.085	134	.102	-.830	.408
	Least vs. Most	.185	64	.112	-1.655	.103
OMS56	Least vs. Average	-.182	42	.147	1.240	.222
	Average vs. Most	-.197	134	.106	1.858	.065
	Least vs. Most	-.094	64	.115	.818	.417

Appendix EE: Inferential statistics for experience contrasts for each oral-motor skill (OMS) within textured puree textures. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	Least vs. Average	-.307	39	.162	1.896	.065
	Average vs. Most	.024	37	.169	-.143	.887
	Least vs. Most	-.283	20	.214	1.321	.201
OMS2	Least vs. Average	-.083	39	.053	1.584	.121
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.083	20	.092	.909	.374
OMS3	Least vs. Average	.158	39	.137	-1.152	.256
	Average vs. Most	-.041	37	.158	.261	.795
	Least vs. Most	.117	20	.152	-.768	.451
OMS4	Least vs. Average	-.115	39	.172	.667	.509
	Average vs. Most	.248	37	.179	-1.390	.173
	Least vs. Most	.133	20	.198	-.674	.508
OMS5	Least vs. Average	-.006	39	.132	.043	.966
	Average vs. Most	.172	37	.123	-1.406	.168
	Least vs. Most	.167	20	.124	-1.348	.193
OMS6	Least vs. Average	-.049	39	.075	.648	.521
	Average vs. Most	-.034	37	.059	.582	.564
	Least vs. Most	-.083	20	.092	.909	.374
OMS7	Least vs. Average	-.083	39	.053	1.584	.121
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.083	20	.092	.909	.374
OMS9	Least vs. Average	-.083	39	.053	1.584	.121
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.083	20	.092	.909	.374
OMS10	Least vs. Average	-.098	39	.103	.946	.350
	Average vs. Most	-.069	37	.082	.838	.407
	Least vs. Most	-.167	20	.124	1.348	.193
OMS11	Least vs. Average	-.106	39	.166	.640	.526
	Average vs. Most	.190	37	.178	-1.066	.293
	Least vs. Most	.083	20	.223	-.374	.712
OMS12	Least vs. Average	.034	39	.054	-.638	.527
	Average vs. Most	-.034	37	.059	.582	.564
	Least vs. Most	n/a	n/a	n/a	n/a	n/a

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS15	Least vs. Average	.034	39	.054	-.638	.527
	Average vs. Most	-.034	37	.059	.582	.564
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS16	Least vs. Average	.500	2	.500	-1.000	.423
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS17	Least vs. Average	.069	39	.075	-.920	.363
	Average vs. Most	-.069	37	.082	.838	.407
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS18	Least vs. Average	.034	39	.054	-.638	.527
	Average vs. Most	-.034	37	.059	.582	.564
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS19	Least vs. Average	-.101	39	.175	.574	.569
	Average vs. Most	-.383	37	.172	2.225	.032*
	Least vs. Most	-.483	20	.187	2.584	.018*
OMS20	Least vs. Average	.247	39	.162	-1.524	.136
	Average vs. Most	.086	37	.186	-.463	.646
	Least vs. Most	.333	20	.195	-1.706	.104
OMS21	Least vs. Average	-.050	38	.178	.282	.779
	Average vs. Most	-.086	37	.186	.463	.646
	Least vs. Most	-.136	19	.225	.606	.552
OMS22	Least vs. Average	.034	39	.054	-.638	.527
	Average vs. Most	-.034	37	.059	.582	.564
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS31	Least vs. Average	-.071	19	.190	.375	.712
	Average vs. Most	.071	19	.190	-.375	.712
	Least vs. Most	.000	12	.202	.000	1.000
OMS32	Least vs. Average	-.077	17	.115	.669	.513
	Average vs. Most	-.066	18	.147	.447	.660
	Least vs. Most	-.143	11	.155	.920	.377
OMS33	Least vs. Average	.069	39	.075	-.920	.363
	Average vs. Most	-.069	37	.082	.838	.407
	Least vs. Most	n/a	n/a	n/a	n/a	n/a

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS34	Least vs. Average	.026	39	.156	-.166	.869
	Average vs. Most	.024	37	.169	-.143	.887
	Least vs. Most	.050	20	.200	-.250	.805
OMS35	Least vs. Average	.207	39	.120	-1.726	.092
	Average vs. Most	.093	37	.158	-.590	.559
	Least vs. Most	.300	20	.139	-2.162	.043*
OMS36	Least vs. Average	.107	38	.165	-.650	.520
	Average vs. Most	-.157	36	.174	.903	.372
	Least vs. Most	-.050	20	.188	.266	.793
OMS37	Least vs. Average	-.075	32	.137	.548	.587
	Average vs. Most	-.025	32	.125	.200	.843
	Least vs. Most	-.100	18	.167	.600	.556
OMS38	Least vs. Average	.020	39	.104	-.193	.848
	Average vs. Most	-.103	37	.099	1.046	.302
	Least vs. Most	-.083	20	.092	.909	.374
OMS39	Least vs. Average	.155	39	.170	-.913	.367
	Average vs. Most	.345	37	.154	-2.235	.032*
	Least vs. Most	.500	20	.166	-3.015	.007*
OMS40	Least vs. Average	-.029	39	.124	.231	.818
	Average vs. Most	-.138	37	.112	1.232	.226
	Least vs. Most	-.167	20	.124	1.348	.193
OMS41	Least vs. Average	.103	39	.090	-1.148	.258
	Average vs. Most	-.103	37	.099	1.046	.302
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS42	Least vs. Average	.055	39	.115	-.475	.637
	Average vs. Most	.162	37	.142	-1.141	.261
	Least vs. Most	.217	20	.166	-1.303	.207
OMS44	Least vs. Average	.034	39	.054	-.638	.527
	Average vs. Most	-.034	37	.059	.582	.564
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS45	Least vs. Average	-.098	39	.103	.946	.350
	Average vs. Most	-.069	37	.082	.838	.407
	Least vs. Most	-.167	20	.124	1.348	.193

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS46	Least vs. Average	.037	39	.172	-.218	.829
	Average vs. Most	.279	37	.168	-1.667	.104
	Least vs. Most	.317	20	.187	-1.693	.106
OMS47	Least vs. Average	.103	39	.090	-1.148	.258
	Average vs. Most	-.103	37	.099	1.046	.302
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS49	Least vs. Average	-.029	39	.124	.231	.818
	Average vs. Most	.262	37	.146	-1.798	.080
	Least vs. Most	.233	20	.193	-1.209	.241
OMS51	Least vs. Average	-.152	36	.165	.920	.364
	Average vs. Most	.000	34	.187	.000	1.000
	Least vs. Most	-.152	18	.202	.750	.463
OMS52	Least vs. Average	.003	36	.142	-.024	.981
	Average vs. Most	-.074	34	.147	.504	.618
	Least vs. Most	-.071	18	.168	.420	.679
OMS53	Least vs. Average	-.037	36	.059	.633	.531
	Average vs. Most	.037	34	.065	-.572	.571
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS54	Least vs. Average	-.037	36	.059	.633	.531
	Average vs. Most	.037	34	.065	-.572	.571
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS55	Least vs. Average	.212	36	.176	-1.204	.236
	Average vs. Most	.000	34	.187	.000	1.000
	Least vs. Most	.212	18	.230	-.921	.369
OMS56	Least vs. Average	-.114	36	.161	.712	.481
	Average vs. Most	.185	34	.169	-1.099	.280
	Least vs. Most	.071	18	.168	-.420	.679

Appendix FF: Inferential statistics for experience contrasts for each oral-motor skill (OMS) within solid texture. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	Least vs. Average	.032	41	.158	-.205	.838
	Average vs. Most	-.157	29	.268	.587	.562
	Least vs. Most	-.125	18	.280	.447	.660
OMS2	Least vs. Average	.037	41	.048	-.766	.448
	Average vs. Most	-.037	29	.098	.379	.707
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS3	Least vs. Average	-.025	41	.068	.375	.710
	Average vs. Most	-.037	29	.098	.379	.707
	Least vs. Most	-.063	18	.128	.490	.630
OMS4	Least vs. Average	-.069	41	.159	.437	.665
	Average vs. Most	-.306	29	.271	1.128	.269
	Least vs. Most	-.375	18	.280	1.342	.196
OMS5	Least vs. Average	-.171	41	.134	1.280	.208
	Average vs. Most	.046	29	.251	-.184	.855
	Least vs. Most	-.125	18	.208	.600	.556
OMS6	Least vs. Average	.037	41	.048	-.766	.448
	Average vs. Most	-.037	29	.098	.379	.707
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS8	Least vs. Average	.037	41	.048	-.766	.448
	Average vs. Most	-.037	29	.098	.379	.707
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS9	Least vs. Average	-.125	41	.065	1.918	.062
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.125	18	.174	.717	.482
OMS10	Least vs. Average	-.025	41	.068	.375	.710
	Average vs. Most	-.037	29	.098	.379	.707
	Least vs. Most	-.063	18	.128	.490	.630
OMS11	Least vs. Average	.185	41	.099	-1.862	.070
	Average vs. Most	-.185	29	.201	.922	.364
	Least vs. Most	n/a	n/a	n/a	n/a	n/a

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS12	Least vs. Average	.111	41	.080	-1.381	.175
	Average vs. Most	-.111	29	.162	.684	.499
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS13	Least vs. Average	-.025	41	.068	.375	.710
	Average vs. Most	-.037	29	.098	.379	.707
	Least vs. Most	-.063	18	.128	.490	.630
OMS14	Least vs. Average	.037	41	.048	-.766	.448
	Average vs. Most	-.037	29	.098	.379	.707
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS15	Least vs. Average	.012	41	.082	-.141	.889
	Average vs. Most	-.074	29	.135	.547	.588
	Least vs. Most	-.063	18	.128	.490	.630
OMS16	Least vs. Average	.500	4	.433	-1.155	.312
	Average vs. Most	.500	3	.645	-.775	.495
	Least vs. Most	1.000	1	.000	n/a	n/a
OMS17	Least vs. Average	.086	41	.103	-.834	.409
	Average vs. Most	-.148	29	.184	.807	.426
	Least vs. Most	-.063	18	.128	.490	.630
OMS19	Least vs. Average	.148	41	.091	-1.629	.111
	Average vs. Most	-.148	29	.184	.807	.426
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS20	Least vs. Average	.032	41	.158	-.205	.838
	Average vs. Most	.343	29	.268	-1.277	.212
	Least vs. Most	.375	18	.280	-1.342	.196
OMS21	Least vs. Average	.049	41	.094	-.520	.606
	Average vs. Most	-.111	29	.162	.684	.499
	Least vs. Most	-.063	18	.128	.490	.630
OMS31	Least vs. Average	-.092	16	.262	.352	.729
	Average vs. Most	-.308	13	.351	.878	.396
	Least vs. Most	-.400	5	.410	.976	.374
OMS32	Least vs. Average	.030	12	.337	-.090	.930
	Average vs. Most	.136	11	.404	-.337	.742
	Least vs. Most	.167	3	.569	-.293	.789

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS33	Least vs. Average	.074	41	.067	-1.105	.276
	Average vs. Most	-.074	29	.135	.547	.588
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS34	Least vs. Average	-.014	41	.104	.134	.894
	Average vs. Most	-.111	29	.162	.684	.499
	Least vs. Most	-.125	18	.174	.717	.482
OMS35	Least vs. Average	-.076	41	.111	.686	.496
	Average vs. Most	.139	29	.184	-.755	.456
	Least vs. Most	.063	18	.235	-.266	.794
OMS36	Least vs. Average	.060	41	.119	-.506	.615
	Average vs. Most	-.185	29	.201	.922	.364
	Least vs. Most	-.125	18	.174	.717	.482
OMS37	Least vs. Average	-.071	38	.052	1.378	.176
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.071	14	.195	.367	.719
OMS38	Least vs. Average	.012	41	.082	-.141	.889
	Average vs. Most	.176	29	.160	-1.096	.282
	Least vs. Most	.188	18	.171	-1.095	.288
OMS39	Least vs. Average	.025	41	.068	-.375	.710
	Average vs. Most	-.213	29	.130	1.636	.113
	Least vs. Most	-.188	18	.171	1.095	.288
OMS40	Least vs. Average	.037	41	.048	-.766	.448
	Average vs. Most	-.037	29	.098	.379	.707
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS41	Least vs. Average	.111	41	.080	-1.381	.175
	Average vs. Most	-.111	29	.162	.684	.499
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS42	Least vs. Average	.146	41	.143	-1.019	.314
	Average vs. Most	-.333	29	.244	1.368	.182
	Least vs. Most	-.188	18	.206	.911	.374

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS44	Least vs. Average	.037	41	.048	-.766	.448
	Average vs. Most	-.037	29	.098	.379	.707
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS45	Least vs. Average	.009	37	.091	-.094	.926
	Average vs. Most	.170	27	.167	-1.019	.317
	Least vs. Most	.179	16	.184	-.972	.345
OMS46	Least vs. Average	.103	37	.090	-1.146	.259
	Average vs. Most	-.460	27	.145	3.170	.004*
	Least vs. Most	-.357	16	.234	1.529	.146
OMS47	Least vs. Average	.080	37	.074	-1.075	.289
	Average vs. Most	-.080	27	.141	.569	.574
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS49	Least vs. Average	.257	37	.152	-1.687	.100
	Average vs. Most	-.400	27	.254	1.576	.127
	Least vs. Most	-.143	16	.186	.770	.453
OMS51	Least vs. Average	-.229	22	.198	1.155	.261
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS52	Least vs. Average	-.357	22	.181	1.971	.061
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS55	Least vs. Average	-.357	22	.158	2.257	.034*
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS56	Least vs. Average	-.100	22	.214	.466	.646
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	n/a	n/a	n/a	n/a	n/a

Appendix GG: Inferential statistics for experience contrasts for each oral-motor skill (OMS) within cracker piece texture. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	Least vs. Average	.091	42	.154	-.592	.557
	Average vs. Most	-.106	37	.198	.535	.596
	Least vs. Most	-.015	15	.206	.074	.942
OMS3	Least vs. Average	.030	42	.053	-.573	.570
	Average vs. Most	.136	37	.098	-1.392	.172
	Least vs. Most	.167	15	.120	-1.393	.184
OMS4	Least vs. Average	.030	42	.178	-.170	.866
	Average vs. Most	.182	37	.226	-.805	.426
	Least vs. Most	.212	15	.264	-.803	.434
OMS5	Least vs. Average	.000	42	.102	.000	1.000
	Average vs. Most	-.091	37	.120	.754	.455
	Least vs. Most	-.091	15	.125	.728	.478
OMS6	Least vs. Average	.030	42	.053	-.573	.570
	Average vs. Most	-.030	37	.072	.422	.676
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS7	Least vs. Average	-.091	42	.051	1.775	.083
	Average vs. Most	.167	37	.067	-2.502	.017*
	Least vs. Most	.076	15	.173	-.438	.668
OMS9	Least vs. Average	-.151	41	.088	1.709	.095
	Average vs. Most	.135	36	.100	-1.360	.182
	Least vs. Most	-.015	15	.206	.074	.942
OMS10	Least vs. Average	-.091	40	.053	1.718	.093
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.091	15	.125	.728	.478
OMS11	Least vs. Average	-.053	40	.126	.420	.676
	Average vs. Most	-.129	35	.141	.917	.365
	Least vs. Most	-.182	15	.168	1.085	.295
OMS12	Least vs. Average	.087	30	.097	-.896	.377
	Average vs. Most	-.087	25	.146	.594	.558
	Least vs. Most	n/a	n/a	n/a	n/a	n/a

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS13	Least vs. Average	-.145	41	.155	.938	.354
	Average vs. Most	.281	36	.196	-1.437	.159
	Least vs. Most	.136	15	.264	-.517	.612
OMS14	Least vs. Average	-.236	41	.156	1.509	.139
	Average vs. Most	.448	36	.193	-2.316	.026*
	Least vs. Most	.212	15	.264	-.803	.434
OMS15	Least vs. Average	-.236	41	.156	1.509	.139
	Average vs. Most	.448	36	.193	-2.316	.026*
	Least vs. Most	.212	15	.264	-.803	.434
OMS20	Least vs. Average	-.091	42	.173	.526	.602
	Average vs. Most	-.030	37	.219	.139	.890
	Least vs. Most	-.121	15	.264	.459	.653
OMS31	Least vs. Average	.007	24	.137	-.048	.962
	Average vs. Most	.082	20	.182	-.452	.656
	Least vs. Most	.089	12	.209	-.425	.679
OMS32	Least vs. Average	.059	21	.101	-.585	.565
	Average vs. Most	.191	19	.166	-1.153	.263
	Least vs. Most	.250	8	.198	-1.265	.242
OMS33	Least vs. Average	.030	42	.053	-.573	.570
	Average vs. Most	.136	37	.098	-1.392	.172
	Least vs. Most	.167	15	.120	-1.393	.184
OMS34	Least vs. Average	.121	42	.101	-1.203	.236
	Average vs. Most	.045	37	.152	-.299	.767
	Least vs. Most	.167	15	.120	-1.393	.184
OMS35	Least vs. Average	.061	42	.074	-.823	.415
	Average vs. Most	-.061	37	.100	.606	.548
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS36	Least vs. Average	-.088	41	.114	.773	.444
	Average vs. Most	.073	36	.140	-.522	.605
	Least vs. Most	-.015	15	.206	.074	.942
OMS37	Least vs. Average	-.091	40	.053	1.718	.093
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.091	15	.125	.728	.478

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS38	Least vs. Average	-.091	42	.112	.810	.422
	Average vs. Most	-.091	37	.120	.754	.455
	Least vs. Most	-.182	15	.168	1.085	.295
OMS39	Least vs. Average	-.061	42	.074	.823	.415
	Average vs. Most	.061	37	.100	-.606	.548
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS41	Least vs. Average	-.030	42	.090	.338	.737
	Average vs. Most	.106	37	.120	-.883	.383
	Least vs. Most	.076	15	.173	-.438	.668
OMS42	Least vs. Average	.121	42	.136	-.890	.378
	Average vs. Most	.121	37	.191	-.635	.529
	Least vs. Most	.242	15	.196	-1.235	.236
OMS44	Least vs. Average	-.091	42	.051	1.775	.083
	Average vs. Most	.167	37	.067	-2.502	.017*
	Least vs. Most	.076	15	.173	-.438	.668
OMS45	Least vs. Average	-.151	41	.088	1.709	.095
	Average vs. Most	-.031	35	.080	.391	.698
	Least vs. Most	-.182	14	.184	.986	.341
OMS46	Least vs. Average	-.188	41	.121	1.556	.127
	Average vs. Most	-.013	35	.194	.065	.949
	Least vs. Most	-.200	14	.129	1.551	.143
OMS47	Least vs. Average	-.060	41	.075	.798	.430
	Average vs. Most	-.031	35	.080	.391	.698
	Least vs. Most	-.091	14	.137	.661	.519
OMS49	Least vs. Average	.128	41	.138	-.927	.359
	Average vs. Most	-.019	35	.204	.092	.927
	Least vs. Most	.109	14	.188	-.579	.572
OMS51	Least vs. Average	.188	18	.285	-.657	.519
	Average vs. Most	.563	16	.372	-1.512	.150
	Least vs. Most	.750	4	.375	-2.000	.116

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS52	Least vs. Average	-.063	18	.235	.266	.794
	Average vs. Most	.313	16	.321	-.972	.345
	Least vs. Most	.250	4	.484	-.516	.633
OMS55	Least vs. Average	-.125	18	.174	.717	.482
	Average vs. Most	.125	16	.248	-.504	.621
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS56	Least vs. Average	.250	18	.228	-1.095	.288
	Average vs. Most	.250	16	.351	-.713	.486
	Least vs. Most	.500	4	.306	-1.633	.178

Appendix HH: Inferential statistics for experience contrasts for each oral-motor skill (OMS) within cracker whole texture. N/A denotes lack of data to calculate contrast. * denotes significant contrast at .05 or less.

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS1	Least vs. Average	-.197	39	.189	1.042	.304
	Average vs. Most	.197	37	.212	-.928	.360
	Least vs. Most	.000	12	.292	.000	1.000
OMS2	Least vs. Average	-.125	39	.059	2.118	.041*
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.125	12	.146	.857	.408
OMS3	Least vs. Average	.091	39	.104	-.872	.388
	Average vs. Most	-.091	37	.120	.754	.455
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS4	Least vs. Average	-.080	39	.200	.397	.693
	Average vs. Most	-.045	37	.227	.200	.842
	Least vs. Most	-.125	12	.286	.436	.670
OMS5	Least vs. Average	-.250	39	.077	3.235	.002*
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.250	12	.191	1.309	.215
OMS6	Least vs. Average	.030	39	.062	-.488	.629
	Average vs. Most	-.030	37	.072	.422	.676
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS7	Least vs. Average	-.125	39	.059	2.118	.041*
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.125	12	.146	.857	.408
OMS9	Least vs. Average	.030	39	.062	-.488	.629
	Average vs. Most	-.030	37	.072	.422	.676
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS12	Least vs. Average	.174	27	.160	-1.084	.288
	Average vs. Most	-.174	25	.197	.883	.386
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS13	Least vs. Average	-.098	39	.151	.651	.519
	Average vs. Most	-.152	36	.165	.920	.364
	Least vs. Most	-.250	11	.211	1.188	.260

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS14	Least vs. Average	-.208	28	.172	1.214	.235
	Average vs. Most	-.125	27	.153	.815	.422
	Least vs. Most	-.333	9	.233	1.430	.186
OMS15	Least vs. Average	-.167	28	.186	.894	.379
	Average vs. Most	-.167	27	.173	.965	.343
	Least vs. Most	-.333	9	.233	1.430	.186
OMS19	Least vs. Average	.121	39	.118	-1.025	.312
	Average vs. Most	-.121	37	.137	.886	.381
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS20	Least vs. Average	.117	39	.166	-.707	.484
	Average vs. Most	.091	37	.198	-.458	.649
	Least vs. Most	.208	12	.232	-.899	.386
OMS24	Least vs. Average	-.103	30	.202	.509	.615
	Average vs. Most	-.231	29	.195	1.185	.246
	Least vs. Most	-.333	9	.233	1.430	.186
OMS26	Least vs. Average	.223	39	.156	-1.432	.160
	Average vs. Most	-.182	37	.172	1.055	.298
	Least vs. Most	.042	12	.279	-.149	.884
OMS27	Least vs. Average	.254	39	.147	-1.732	.091
	Average vs. Most	-.045	37	.152	.299	.767
	Least vs. Most	.208	12	.257	-.812	.433
OMS28	Least vs. Average	-.125	39	.059	2.118	.041*
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.125	12	.146	.857	.408
OMS29	Least vs. Average	-.034	39	.120	.285	.777
	Average vs. Most	-.091	37	.120	.754	.455
	Least vs. Most	-.125	12	.146	.857	.408
OMS30	Least vs. Average	-.322	39	.188	1.716	.094
	Average vs. Most	.197	37	.212	-.928	.360
	Least vs. Most	-.125	12	.286	.436	.670
OMS31	Least vs. Average	.074	22	.261	-.282	.780
	Average vs. Most	-.224	21	.281	.795	.435
	Least vs. Most	-.150	7	.354	.424	.685

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS32	Least vs. Average	.028	20	.258	-.108	.915
	Average vs. Most	-.028	20	.258	.108	.915
	Least vs. Most	.000	6	.354	.000	1.000
OMS33	Least vs. Average	.033	35	.070	-.478	.636
	Average vs. Most	-.033	32	.093	.360	.721
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS34	Least vs. Average	n/a	n/a	n/a	n/a	n/a
	Average vs. Most	.250	32	.081	-3.068	.004*
	Least vs. Most	.250	9	.181	-1.382	.200
OMS35	Least vs. Average	-.152	35	.157	.971	.338
	Average vs. Most	-.133	32	.175	.761	.452
	Least vs. Most	-.286	9	.250	1.144	.282
OMS36	Least vs. Average	-.024	32	.164	.145	.886
	Average vs. Most	-.143	30	.181	.791	.435
	Least vs. Most	-.167	8	.208	.800	.447
OMS39	Least vs. Average	-.100	35	.117	.858	.397
	Average vs. Most	-.150	32	.175	.858	.397
	Least vs. Most	-.250	9	.181	1.382	.200
OMS40	Least vs. Average	.067	35	.097	-.688	.496
	Average vs. Most	-.067	32	.129	.519	.608
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS41	Least vs. Average	.033	35	.070	-.478	.636
	Average vs. Most	-.033	32	.093	.360	.721
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS42	Least vs. Average	-.074	34	.119	.620	.539
	Average vs. Most	-.069	31	.131	.528	.602
	Least vs. Most	-.143	9	.193	.739	.479
OMS45	Least vs. Average	-.167	32	.073	2.296	.028*
	Average vs. Most	n/a	n/a	n/a	n/a	n/a
	Least vs. Most	-.167	8	.208	.800	.447
OMS46	Least vs. Average	-.214	32	.173	1.241	.224
	Average vs. Most	.214	30	.212	-1.011	.320
	Least vs. Most	n/a	n/a	n/a	n/a	n/a

OMS	Experience contrast	Mean Difference	df	Std. Error Difference	t value	p value
OMS47	Least vs. Average	-.167	32	.073	2.296	.028*
	Average vs. Most	.250	30	.085	-2.958	.006*
	Least vs. Most	.083	8	.287	-.290	.779
OMS49	Least vs. Average	.179	32	.161	-1.108	.276
	Average vs. Most	-.179	30	.198	.903	.374
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS51	Least vs. Average	-.450	22	.260	1.732	.097
	Average vs. Most	.367	21	.298	-1.230	.232
	Least vs. Most	-.083	5	.407	.205	.846
OMS52	Least vs. Average	.000	22	.248	.000	1.000
	Average vs. Most	.417	21	.284	-1.467	.157
	Least vs. Most	.417	5	.407	-1.025	.352
OMS54	Least vs. Average	-.100	22	.157	.638	.530
	Average vs. Most	.100	21	.181	-.552	.587
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS55	Least vs. Average	-.100	22	.157	.638	.530
	Average vs. Most	.100	21	.181	-.552	.587
	Least vs. Most	n/a	n/a	n/a	n/a	n/a
OMS56	Least vs. Average	-.050	22	.285	.176	.862
	Average vs. Most	.217	21	.320	-.677	.506
	Least vs. Most	.167	5	.441	-.378	.721

Appendix II: Performance level for each oral-motor skill (OMS) and texture by children in the least amount of experience group. Performance level is indicated by "x" when 0-24%, 25-49%, 50-74% and 75-100% of children performed each skill. Note that bolded items and grayed areas are only to aid in discrimination of data. A "-" denotes when a skill is not relevant to the texture.

Least experienced group																				
Performance Level																				
%	**0-24**					25-49					**50-74**					75-100				
OMS	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW
1						x	x						**x**		**x**				x	
2																x	x	x	x	x
3																x	x	x	x	x
4	**x**						x	x		x				**x**						
5		**x**	**x**			x													x	x
6																x	x	x	x	x
7																x	x	x	x	x
8																x	x	x	x	x
9																x	x	x	x	x
10																x	x	x	x	x
11											**x**	**x**						x	x	x
12																x	x	x	x	x
13														**x**		x	x	x		x
14														**x**	**x**	x	x	x		
15														**x**	**x**	x	x	x		
16				**-**	**-**				-	-				**-**	**-**	x	x	x	-	-
17				**-**	**-**				-	-				**-**	**-**	x	x	x	-	-
18				**-**					-					**-**		x	x	x	-	x
19						x	x											x	x	x
20											**x**		**x**	**x**			x			x
21				**-**	**-**	x	x		-	-				**-**	**-**			x	-	-
22																x	x	x	x	x
24	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**	**x**	-	-	-	-	
25	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
26	**-**	**-**	**-**	**-**		-	-	-	-	x	**-**	**-**	**-**	**-**		-	-	-	-	
27	**-**	**-**	**-**	**-**		-	-	-	-	x	**-**	**-**	**-**	**-**		-	-	-	-	
28	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
29	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
30	**-**	**-**	**-**	**-**		-	-	-	-	x	**-**	**-**	**-**	**-**		-	-	-	-	
31	**-**	**x**				-					**-**		**x**		**x**	-			x	
32	**-**	**x**				-					**-**		**x**			-			x	x
33																x	x	x	x	x
34																x	x	x	x	x
35															**x**	x	x	x	x	
36											**x**						x	x	x	x
37																x	x	x	x	x
38																x	x	x	x	x
39			**x**	**x**	**x**						**x**	**x**								
40											**x**						x	x	x	x
41																x	x	x	x	x
42																x	x	x	x	x
44																x	x	x	x	x
45																x	x	x	x	x
46			**x**	**x**	**x**		x				**x**									
47																x	x	x	x	x
49																x	x	x	x	x
51	**x**	**x**	**x**							x									x	
52													**x**			x	x		x	x
53	**x**	**x**	**x**	**x**	**x**															

Least experienced group (continued)																				
Performance Level																				
%	0-24					25-49					50-74					75-100				
OMS	SP	TP	S	CP	CW	SP	TP	S	CP	CW	SP	TP	S	CP	CW	SP	TP	S	CP	CW
54	x	x	x	x	x															
55	x		x	x	x							x								
56	x	x						x							x				x	

Appendix JJ: Performance level for each oral-motor skill (OMS) and texture by children in the average experienced group. Performance level is indicated by "x" when 0-24%, 25-49%, 50-74% and 75-100% of children performed each skill. Note that bolded items and grayed areas are only to aid in discrimination of data. A "-" denotes when a skill is not relevant to the texture.

Average experienced group																				
Performance Level																				
%	**0-24**					25-49					**50-74**					75-100				
OMS	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW
1											**x**	**x**	**x**	**x**	**x**					
2																x	x	x	x	x
3																x	x	x	x	x
4						x	x	x		x				**x**						
5	**x**	**x**						x											x	x
6																x	x	x	x	x
7																x	x	x	x	x
8																x	x	x	x	x
9																x	x	x	x	x
10																x	x	x	x	x
11						x						**x**						x	x	x
12																x	x	x	x	x
13																x	x	x	x	x
14																x	x	x	x	x
15																x	x	x	x	x
16				**-**	**-**				-	-			**x**	**-**	**-**		x		-	-
17				**-**	**-**				-	-				**-**	**-**	x	x	x	-	-
18				**-**					-					**-**		x	x	x	-	x
19						x						**x**						x	x	x
20											**x**	**x**	**x**	**x**						x
21				**-**	**-**	x	x		-	-				**-**	**-**			x	-	-
22																x	x	x	x	x
24	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
25	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
26	**-**	**-**	**-**	**-**	**x**	-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	
27	**-**	**-**	**-**	**-**	**x**	-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	
28	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
29	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
30	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**	**x**	-	-	-	-	
31	**-**	**x**				-					**-**		**x**		**x**	-			x	
32	**-**	**x**				-					**-**		**x**		**x**	-			x	
33																x	x	x	x	x
34											**x**						x	x	x	x
35																x	x	x	x	x
36						x						**x**						x	x	x
37																x	x	x	x	x
38																x	x	x	x	x
39			**x**	**x**	**x**	x	x													
40																x	x	x	x	x
41																x	x	x	x	x
42													**x**			x	x		x	x
44																x	x	x	x	x
45																x	x	x	x	x

Average experienced group (continued)																				
Performance Level																				
%	**0-24**					25-49					**50-74**					75-100				
OMS	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW
46			**x**	**x**	**x**	x	x													
47																x	x	x	x	x
49													**x**			x	x		x	x
51	**x**						x	x						**x**	**x**					
52																x	x	x	x	x
53	**x**	**x**	**x**	**x**	**x**															
54	**x**	**x**	**x**	**x**	**x**															
55				**x**	**x**	x	x	x												
56						x	x						**x**		**x**				x	

Appendix KK: Performance level for each oral-motor skill (OMS) and texture by children in the most experienced group. Performance level is indicated by "x" when 0-24%, 25-49%, 50-74% and 75-100% of children performed each skill. Note that bolded items and grayed areas are only to aid in discrimination of data. A "-" denotes when a skill is not relevant to the texture.

Most experienced group																				
Performance Level																				
%	**0-24**					25-49					**50-74**					75-100				
OMS	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW
1											**x**	**x**			**x**			x	x	
2																x	x	x	x	x
3																x	x	x	x	x
4		**x**				x			x						**x**			x		
5	**x**	**x**						x											x	x
6																x	x	x	x	x
7																x	x	x	x	x
8																x	x	x	x	x
9																x	x	x	x	x
10																x	x	x	x	x
11											**x**	**x**						x	x	x
12																x	x	x	x	x
13														**x**		x	x	x		x
14									x							x	x	x		x
15									x							x	x	x		x
16			**x**	**-**	**-**				-	-				**-**	**-**				-	-
17				**-**	**-**				-	-				**-**	**-**	x	x	x	-	-
18				**-**					-					**-**		x	x	x	-	x
19											**x**						x	x	x	x
20						x		x				**x**		**x**	**x**					
21				**-**	**-**				-	-	**x**	**x**		**-**	**-**			x	-	-
22																x	x	x	x	x
24	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
25	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
26	**-**	**-**	**-**	**-**		-	-	-	-	x	**-**	**-**	**-**	**-**		-	-	-	-	
27	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	
28	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
29	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**		-	-	-	-	x
30	**-**	**-**	**-**	**-**		-	-	-	-		**-**	**-**	**-**	**-**	**x**	-	-	-	-	
31	**-**	**x**				-					**-**					-		x	x	x
32	**-**	**x**				-					**-**		**x**			-			x	x
33																x	x	x	x	x
34											**x**	**x**						x	x	x
35												**x**				x		x	x	x
36											**x**						x	x	x	x
37																x	x	x	x	x
38																x	x	x	x	x
39		**x**		**x**		x		x		x										
40																x	x	x	x	x
41																x	x	x	x	x
42												**x**		**x**		x		x		x
44																x	x	x	x	x
45																x	x	x	x	x

Most experienced group (continued)																				
Performance Level																				
%	**0-24**					25-49					**50-74**					75-100				
OMS	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW	**SP**	**TP**	**S**	**CP**	**CW**	SP	TP	S	CP	CW
46		**x**		**x**		x							**x**							
47																x	x	x	x	x
49												**x**				x		x	x	x
51				**x**		x	x			x										
52										x				**x**		x	x			
53	**x**	**x**		**x**																
54	**x**	**x**		**x**																
55				**x**			x				**x**									
56		**x**				x				x				**x**						