EFFECTS OF NOVEL INGESTA FROM NOVEL PRESENTERS ON FOOD ACCEPTANCE IN INFANTS OF DIFFERENT AGES

by

Lera Joyce Johnson

Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in Developmental Psychology

APPROVED:

Joseph J. Franchina, Chair

Robert E. Lickliter

David Harrison

Robin P. Cooper

Thomas Sherman

March 31, 1993

Blacksburg, Virginia

EFFECTS OF NOVEL INGESTA FROM NOVEL PRESENTERS ON FOOD ACCEPTANCE IN INFANTS OF DIFFERENT AGES

by

Lera Joyce Johnson

(ABSTRACT)

The present study investigated food acceptance/ ingestional neophobia as a function of distal and proximal sources of stimulus novelty in human infants of two ages and evaluated the utility of the two-stage model of ingestion (e.g., Garcia, Hankins, & Rusiniak, 1974) in understanding the role of novel cues in food acceptance.

Thirty-two infants (6- to 12-months-of-age) and 32 toddlers (13- to 24-months-of-age) received a familiar or a novel food from a familiar or a novel presenter during lunchtime at a day care center. The measures of performance were latency to the first and second bites, percentage frequencies of gustofacial expressions, behavioral indices of food rejection, such as spitting out the food, pushing the food away and upper body flexion, and percentage intake.

Reliably longer latencies occurred to the novel than to the familiar presenter on first and second bites for both age groups. No reliable effects were found to the appearance of the novel food on latencies to the first bite or to the taste cues of the novel food on latencies to the second bite for either age group. Combinations of novel presenter and novel food cues did not produce reliably longer latencies to the second bite than did mixed combinations of novel/familiar cues. However, infants, but not toddlers, showed reliably longer latencies to the novel than to the familiar presenter in the novel food condition prior to the second bite. No reliable age differences were observed in negative gustofacial responses to novel foods. Latencies to the first and second bites were reliably correlated with percentage intake and behavioral indices of aversiveness such as upper body flexion and pushing the food away. These data suggested that demonstration of neophobia may be an indication of aversiveness of novelty.

Finding that ingestional neophobia occurred to novel presenter cues supported the view of the two-stage model that distal cues influence approach behavior and the start of ingestion. However, the model was not supported by data for the second bite. Failure to find reliable effects to food cues in latencies to the second bite did not support the view that proximal food cues influence the continuation of ingestion. The prediction for greater neophobia to combinations of novel cues was not supported. Reliable differences in latencies to the second bite for infants, but not for toddlers, who received a novel food from a novel presenter suggest developmental differences in ingestional neophobia.

DEDICATION

I dedicate this dissertation

to the loving memory of

my Grandma,

Blanche May Powell

1895-1984

who believed in me and

in the value of education.

This dissertation is also dedicted to the memory

of my colleague and dear friend,

Jeffrey Mark Piston

1960-1991

who shared my love of learning in general

and my love of this discipline in particular.

- * -

Omnia mutantur, nos et mutamur in illis.

ACKNOWLEDGEMENTS

I thank the members of my committee, Drs. Franchina, Lickliter, Harrison, Cooper and Sherman for sharing their expertise with me toward the successful completion of this project. Quot homines, tot sententiae.

I especially thank Dr. Franchina for giving me guidance and specific feedback throughout the pursuit of this project. It has been a privilege to work with him and his lab team for the past five years. I sincerely admire his persistent striving for perfection. Non sum qualis eram.

My appreciation also goes to Dr. Ellie Sturgis for the generous use of her video equipment and lab. I want to thank Dr. Robin Panneton Cooper for her contributions to the construction of the rating instrument, her invaluable contributions to the content of the paper, and access to the list of potential subjects from her laboratory for my pilot study. I appreciate her confidence in my handling of her valuable resources and the opportunity to make every mistake possible in pilot testing. I certainly did my best on both counts. I also thank Dr. Dave Harrison for his help in gathering resources for and evaluating our customized rating instrument. I am grateful to Dr. Franchina's research assistants and to Dr. Timothy Ludwig for help with the construction of the rating instrument. Edition IX worked.

I thank all the "novel presenters" who generously donated their time and expertise:

Pam Schuetze	Jane Abraham	Marty Brown
Karyn Carr	Beth Soeken	Laura Hough

I am grateful to Robert Smith and David Wright for rating the videotapes. I have fondly referred to Barry Garst who assisted with the exhaustive data entry- 140 data points for 80 observations- as "the elf". If there weren't so much evidence otherwise, I'd think it was magic. I want to thank Barry. I am grateful to Jane Abraham and Pam Schuetze for help in videotaping data. I could not have done this alone.

This study would not have been possible without the permission and cooperation of the parents, children, owners and staff at the following day care centers:

Corporate Child Care Management Services	Roanoke, Va.
Honey Tree Learning Centers:	
460-East	Roanoke, Va.
Lewis-Gale Hospital	Salem, Va.
McVitty Road	Roanoke, Va.
Roanoke Memorial Hospital	Roanoke, Va.
Shawvalle Tots & Child Care Center	Shawsville, Va.
Downtown Learning Center	Roanoke, Va.
Mt. Tabor Nursery School & Day Care Center	Blacksburg, Va.
Calvary Baptist Church Inf. Child Care Cntr.	Roanoke, Va.
Church Court Day Nursery & Kindergarten	Roanoke, Va.
Sonshine Christian Education Ministries, Inc.	Roanoke, Va.
Hugs N More	Pearisburg, Va.

I wish to thank each of them for their participation.

A special word of appreciation goes to Dr. Paul F. White, Pediatric Allergy specialist with Lewis-Gale Clinic, Salem, Virginia for donating his coveted time to consult with me about the list of potential food stimuli and the symptoms of food-related allergic reactions. I appreciate the work of the Chef and Sous-Chef at Donaldson Brown Conference Center for preparing some of the food stimuli.

I wish to thank my mother, Lera Powell Pylant, for her enthusiasm about learning, support for my education and help with my children so that I could complete this degree. I thank my former roommates, Jan Richards Cermele and Lisa Schaaf, for their saintly tolerance and for being the wind beneath my wings. I acknowledge the sacrifices that my former husband, Mark Charles Johnson, made to my higher education. My sincere thanks go to my dear friend, Frances Kay "Katie" Wick, for her loyal support, faith, humor, love and friendship. I want to thank her for her technical assistance in preparing the final manuscript. I sincerely love and appreciate my social support group and colleagues, Jane Abraham, Cynthia Lease, David Jaques, and Betty Gillespie for nurturing my physical, spiritual, mental and emotional health with companionship, love and humor. I also thank Dr. Brian Warren for giving me encouragement, guiding my personal and professional development and equipping me with coping strategies.

Finally, I need to thank my precious daughters, Sarah Christine, Heather May and Leslie Ruth Johnson for their love, patience, humor, help, encouragement and support.

Table of Contents

List of Tables

List of Figures

INTRODUCTION

Across cultures, humans routinely accept a diversity of foods at the risk of ingesting toxic agents or consuming an imbalanced diet (Rozin, 1976, 1990a). As an omnivore, the human must discover what is (in)edible, what foods can(not) be combined and what quantities are safe to eat (Rozin, 1990a). Opportunities to experience variety in foods can be limited by the avoidance of novel stimuli in the feeding situation. Despite cultural diversity in eating patterns, little is known about how an individual's prior experience with ingesta influences the development of food acceptance (Birch, 1990a).

Ingestional neophobia is a phenomenon in which refusals may occur to foods which have a novel taste (flavor) or appearance, are served in a novel location or container, or are received from a novel presenter. Research has shown that preexposure to a food increases the likelihood of its being accepted, presumably because preexposure reduces novelty and thereby attenuates neophobia (Domjan, 1976; Siegel, 1974; Tarpy & McIntosh, 1977).

Parents of children between the ages of two and five frequently complain that their children eat a very narrow range of foods (Bakwin & Bakwin, 1972; Benjamin, 1942; Pelchat & Pliner, 1986; Rozin, 1990a). Children's categorical refusal of novel foods strongly resembles the phenomenon of ingestional neophobia. Birch and Marlin (1982) emphasized this tendency when they humorously entitled their study of preexposure effects on two-year-old children's food preferences: "I don't like it; I've never tried it." The apparent tendency of some children to avoid new foods by age two is counterintuitive for at least two reasons. First, if this pattern of food refusal represents ingestional neophobia, we would expect that the preexposure variable which affects neophobia would be influential in reducing food refusals. In this context, preexposure refers to the prior ingestional experience of children during the two years postpartum. Secondly, research has shown that older infants tend to attend longer to, approach, and sometimes, prefer, moderately novel visual stimuli (Cohen, 1973). Thus, we would expect young children to respond favorably to novel ingesta rather than to avoid them.

It is important to note that the incidence of refusals to novel foods by children younger than age two has never been formally quantified. There are anecdotal references that refusals to novel foods typically emerge around age two (e.g., Duncker, 1938), but no studies have documented developmental differences in food acceptance in infants between 6- and 24-months-of-age (Davis, 1928, 1939; Birch, 1990a, 1990b; Harper & Sanders, 1975). The present study investigated food acceptance in infants and young children from the perspective of ingestional neophobia. That is, we studied the effects of variables which are generally known to affect neophobia on food acceptance in infants of two ages.

The organization of this paper is as follows:

I. Ingestional Neophobia
   A. Novelty in the Organism-Environment Interaction
   B. Variables in Ingestional Neophobia
II. Preexposure
   A. Preexposure and Testing with the Same Ingesta
   B. Preexposure and Testing with Different Ingesta
   C. Differences in Preexposure Effects Over Ontogeny
III. Human Food Acceptance
   A. Factors in Human Food Acceptance
   B. Effects of Novelty on Food Acceptance
   C. Developmental Differences in Food Acceptance
IV. Methodology in Studies of Food Acceptance
   A. Operational Definitions of Food Acceptance
   B. Measurement Approaches
   C. The Two-Stage Model of Ingestion
V. Research Design

I. Ingestional Neophobia

Domjan (1977) classifies ingestive behavior as one of the most intimate interactions between an organism and the environment. Subjects confronted with a novel substance generally cannot detect whether the substance has lethal postingestional consequences. Avoidance of the substance may arise because there is no way for an organism to predict postingestional consequences. Thus, ingestional neophobia provides protection from harmful substances by ensuring that organisms will avoid eating much of unfamiliar substances (Domjan & Burkhard, 1982).

Ingestional neophobia refers to the reluctance to ingest a novel food/drink, or a familiar food/drink presented in a novel container or a new place, relative to ingestion of the same edible when it is familiar (Domjan, 1977, 1982). Ingestional neophobia was originally noted in the context of baiting rats for poisoning. Shorten (1954; Domjan, 1977) located what may be the earliest reference to the phenomenon in a report written in 1768 by Robert Smith, rat-catcher to Princess Amelia of England. Smith advised that one should expect several days to elapse after placing a new bait container before rats will approach it, and that one ought to prebait the trap before poisoning the bait. Subsequent research has confirmed Smith's observation that neophobia may appear to a novel change in an otherwise familiar context (Barnett, 1975; Chitty, 1954). As for the practical decision regarding prebaiting, subsequent research has also shown that rats eat less of a novel food than of a familiar one (see Domjan, 1976, 1977 for review).

The suppression of eating which characterizes ingestional neophobia is attributed to the aversiveness of novelty (Barnett, 1963; Braveman & Jarvis, 1978). Aversiveness is inferred from avoidance behaviors and apparent agitation (Domjan, 1977). Domjan (1976, Experiment 1) observed that presenting rats with a novel saccharin solution resulted in the rats' rattling and biting parts of their cages. Rats who were presented with novel saccharin through an oral fistula attempted to jump out of the infusion cages (Domjan, 1976, Experiment 4). Coppinger (1969) noted that presentation of novel foods to wild-caught blue jays resulted in their raising their crests, alarm calling and retreating. When jays were presented with novel butterflies, they flew frantically about the cage. Braun-Bartana, Ganchrow, & Steiner (1986) reported that aversive reactions to weak quinine and acid aqueous taste solutions included head shaking, prolonged beak clapping, beak wiping, gaping, and fewer fluid contacts.

Novelty is a nonspecific characteristic which presumably results from a comparison between current stimuli and stimuli previously experienced from the same class (Domjan & Burkhard, 1982; Wagner, 1976, 1978, 1979). Novelty is detectable as a stimulus characteristic even though novelty holds no distinct properties of its own

(Braveman & Jarvis, 1978; Franchina & Dyer, 1989). In fact, novel ingesta may function as a deterrent even if the novel taste is highly palatable. For example, Rozin (1976) has cited a study by Weiskrantz and Cowey (1963) that examined the response of rhesus monkeys to highly palatable novel foods, such as black currant juice or chocolate malted drink. The monkeys tended to sample the novel foods immediately, but they consumed very little for the first few days and increased their intake only after exposure over several weeks.

Reluctance to consume a novel food may prevent consumption of a nutritionally favorable food if the latter is novel and is paired against a familiar food, which may be nutritionally inferior. Hogan (1971, 1973) reported that chicks died after consuming a nutritionally-inadequate diet of mealworms because they avoided the more-nutritious alternative which was novel. Rabinowitch (1961) raised chickens on milo or wheat for six weeks then offered the other grain, wheat or milo, as novel. Half of the chicks starved to death in the presence of the novel food (Rabinowitch, 1961, c.f., Rabinowitch, 1968). When two unfamiliar foods were presented as the choice pair, many birds starved to death (Rabinowitch, 1968, p.427).

The uniqueness and potency of neophobia has been tested by pitting it against other powerful influences on behavior such as conditions of deprivation (Domjan, 1976), punishment (Mitchell, Fairbanks, & Laycock, 1977; Mitchell, Kirschbaum, & Perry, 1975; Mitchell, Scott, & Williams, 1973), and reinforcement (Cross & Vaughter, 1966; Fisher, Sperber, & Zeaman, 1973; House & Zeaman, 1958; Grabbe & Campione, 1969; Moss & Harlow, 1947; Zeaman & Hanley, 1983). Neophobia to a novel-flavored solution, saccharin, suppressed intake in fluid-deprived rats, despite the palatability of the solution (Domjan, 1976). Studies of physiological thirst have shown that the amount of water that thirsty rats drink varies with how severely fluid-deprived they are (Blass & Hall, 1976; Mook, 1987). Taste-evoked drinking occurs after preexposure to water sweetened with sugar (nutritive) or saccharin (nonnutritive). When a container of familiar sweetened solution is presented to a rat in its home cage with food and water available ad libitum, a non-deprived rat will rush to the container and drink two to three times its total blood volume (Ernits & Corbit, 1973). When neophobia was pitted against physiological thirst and taste-evoked drinking, Domjan (1976) found that neophobia wielded the greater control over behavior. Results showed that the more novel the solution, the less was ingested despite the palatability of the solution or increased levels of fluid deprivation.

Preference for novel or familiar cues has been tested against reinforcement theory. Reinforcement theory, based on Thorndike's law of effect (Thorndike, 1898, 1911), proposes that the likelihood that a behavior will be repeated is dependent on the consequences of that behavior which are operative in the environment. A behavior that is followed closely in time by pleasurable consequences or rewards is strengthened and more likely to be repeated. A behavior that is followed closely in time by noxious, unpleasant consequences, or punishers is weakened or less likely to be repeated. Mitchell, Osborne, and O'Boyle (1985) used shock-escape training to evaluate predictions of reinforcement and neophobia theories in a simple choice task. In an alternation task using a T-Maze, the rats entered the runway under footshock conditions and choice contingencies were manipulated to reinforce choice of a novel context. Alternation or perseveration of novel or familiar alley choices at the "T" over successive trials were negatively reinforced by shock termination or punished by shock continuation, respectively. The reinforcement view would predict that rats would repeat the rewarded response independent of the novelty or familiarity of the context. However, Mitchell et al. found that rats avoided the novel context despite its being reinforced. This evidence inconsistent with reinforcement theory but consistent with patterns of neophobia/habituation in aroused organisms.

The Moss-Harlow learning design (Moss & Harlow, 1947) has been used to demonstrate cue preferences within the novelty/familiarity dimension. The Moss-Harlow paradigm provides an index of relative preference for novel and familiar stimuli by comparing the subject's reactions to reward contingencies in the positive and negative subconditions of the design. Each subcondition consists of two trials. On the first trial, the subject is presented with a single stimulus. In the positive subcondition, the single stimulus of Trial 1 is paired with a reward. In the negative subcondition, the single stimulus of Trial 1 is not reinforced. On the second trial, the subject is presented with a choice of the now familiar stimulus from the first trial and a second, novel stimulus. In the positive subcondition, Trial 2 presents a choice between a familiar, rewarded stimulus and a novel stimulus. In the negative subcondition, Trial 2 presents a choice between a familiar, nonreinforced stimulus and a novel stimulus. Cue preference is determined by comparing the choice of novel versus familiar stimuli in the second trial under each subcondition. The percentage difference in choice for novel versus familiar stimuli is a measure of the subject's attraction to the cue despite having been (non)reinforced for an alternate cue. Reinforcement theory predicts that choices followed by reinforcement will have a higher likelihood of being repeated despite the novelty or familiarity of the stimulus. The Moss-Harlow learning design demonstrated that stimulus preference for novelty or familiarity had greater influence on choice response in the second trial than did the reinforcement contingencies of the first trial. Younger children about mental age two preferred to approach novel cues more than did older children. However, about mental age four or five, cue preferences changed from novelty to familiarity (Zeaman, 1976; Zeaman & Hanley, 1983).

Kurz and Levitsky (1983) used an aversion-conditioning paradigm to compare the effects of conditioned spatial aversions with those of spatial neophobia. Two groups of rats were preexposed to a chamber, A, or not preexposed prior to conditioning. Half of each group received a lithium injection and the other half received a saline injection in Chamber A on the conditioning day. In testing, rats were presented a choice between Chamber A or a novel chamber, B. Conditioning theory would predict that rats who were poisoned in the first chamber, A, would have established an aversion to that space and would, thereby, prefer Chamber B, despite its novelty. A theory of spatial neophobia would predict, however, that rats would avoid the novel chamber, B, despite aversion conditioning to Chamber A. Results supported spatial neophobia theory. All groups spent reliably less time in the novel chamber, B, during testing, especially those who had received a lithium injection after preexposure to Chamber A. The authors suggested that lithium injection may have actually produced an increase in neophobia.

IA. Novelty in the Organism-Environment Interaction

Independent indices of interactions between organism and novel stimuli show similar functional relationships. For example, neophobia as a function of flavor concentration (Miller & Holzman, 1981a, pp.17, 40-41; Ganchrow, Oppenheimer, & Steiner, 1979) and the novelty/familiarity continuum proposed by Piaget (1952) follow an inverted U-shaped function.

Piaget's (1952) cognitive-developmental theory holds that novelty and familiarity occur along a continuous dimension depending on the child's schemata and prior experience with the stimulus. In reference to an infant's visual preference, Piaget stated that the child would not look at what was too familiar because s/he was satiated with it, and would not look at a highly discrepant stimulus if the discrepant stimulus could not be functionally assimilated into the child's existing schemes. Preference for moderate discrepancy has been confirmed in numerous studies (Eson, Cometa, Allen, & Henel, 1977; Fantz, 1964; Munsinger & Kessen, 1964; Smock & Holt, 1962; Switzky, Haywood, & Isett, 1974; Thomas, 1966; Weizmann, Cohen, & Pratt, 1971). Fantz (1964) found that infants showed an increased preference for novel visual patterns around two- to three-months of age. Infants younger than two months of age did not show preference for either familiar or novel visual stimuli but infants over two months of age did show preference for novel stimuli. Greenberg, Uzgiris, and Hunt (1970) also found that very young infants would develop a preference for novel visual displays at about two months of age if they were provided with sufficiently long exposures. A change in preference for moderately novel stimuli to a preference for familiar stimuli between the ages of four and five has been observed in discriminative learning tasks using the Moss-Harlow design (Moss & Harlow, 1947) (Fisher, Sperber, & Zeaman, 1973). The attraction to moderate novelty may be interpreted in Piagetian notions of aliment as an active preference for scheme expansion and cognitive growth. On this view, cognitive aliments are metaphorically equated with nutritive aliments (Eson et al., 1977).

Berlyne and Slater (1957) found that rats that received an amphetamine injection responded at higher rates to familiar than to novel stimuli, but saline-injected rats responded at higher rates to novel than to familiar stimuli. Berlyne (1960, 1968, 1969; Barnett 1963, 1975) proposed that an organism's response to novelty depends on an interaction of organismic and environmental factors which includes 1) the organism's initial state of arousal, and 2) the arousal value of the stimulus. Berlyne hypothesized that the interaction of these two factors determined whether the reward system or the aversion system in the brain would be more active (Barnett, 1975, p. 45). Similarly, Schneirla (1939, 1959) predicted that low intensities of stimulation would tend to evoke approach reactions and that high intensities would evoke withdrawal reactions (1959, p.3).

Schneirla (1957) analyzed behavioral development in respect to phenomena within the organism (e.g., reactivity) and phenomena in the context of the organism (e.g., weak vs. strong stimuli). Schneirla's (1959) concept of approach/withdrawal posited that prior experience with stimulation affected the organism's reaction to stimulation postnatally. The tendency to approach weak stimuli and avoid strong stimuli is regulated by prenatal experience with stimuli (Boice, 1976). Thus, the reactivity of the organism, which is present at birth, may become a biological determinant of food acceptance.

The foregoing explanations suggest that novelty is a continuum rather than a dichotomy and that the determination of novelty arises from an interaction of the organism, as influenced by its prior history, and the current stimulus. Inherent in this explanation is the principle that novelty is separable from other specific stimulus characteristics such as taste, temperature, olfactory, visual or textural cues. The ethological view (e.g., Rozin & Kalat, 1972) offers an alternate explanation; namely, that food selection follows an adaptive pattern of approach and avoidance based on ecological relevance (e.g., Kare & Beauchamp, 1985) or salience (Kalat & Rozin, 1970). This view holds that neophobia does not occur to novelty as a nonspecific stimulus characteristic, but that neophobia occurs to specific classes of novel stimulus characteristics which are of peculiar importance to that species. For example, differential taste responses are believed to have an evolutionary basis because, for some species, sweet tastes are highly correlated with sources of nourishment and bitter tastes are similarly correlated with most toxins. Some individuals can detect the bitter taste of phenylthiocarbamide (PTC) (Amerine, Pangborn, & Roessler, 1965) whose analog in vegetables has an anti-thyroid or goitrogenic effect (Kare & Beauchamp, 1985). In areas where goiter is endemic, iodine is low and thyroids are stressed. According to an ethological view, PTC tasters would have an adaptive advantage because they would avoid the bitter taste of vegetables containing the goitrogen. This hypothesis has been supported by correlational evidence (Greene, 1974). Species differences have also been found in taste responsiveness to sweet and salty substances (Kare & Beauchamp, 1985). For example, lions, tigers, leopards, jaguars, domestic cats, chickens, gulls, armadillos and hedgehogs do not show preferences for sweet tastes. The lack of preference for sweet in these species is believed to typify ecological systems wherein species are equipped with sensory responses most adaptive to their particular niche. After all, carnivorous cats do not eat foods with sugar; consequently, sugar preference is unnecessary and possibly counterproductive (Kare & Beauchamp, 1985).

According to the ethological perspective, greater neophobia should occur to ecologically relevant than to ecologically irrelevant stimuli. That is, post hoc analyses suggest an environmentally-selected genetic predisposition of a species to avoid tastes highly relevant to sources of nourishment and tastes highly relevant to sources of naturally-occurring toxins. This view would predict that neophobia would not occur to tastes common to ecologically irrelevant stimuli, and that neophobia to ecologically irrelevant stimuli would be more readily attenuated through preexposures than would neophobia to highly relevant stimuli. In tests of the former hypothesis, Miller and Holzman (1981a) found no evidence of neophobia to support the hypothesis that neophobia would not occur to ecologically irrelevant stimuli. Rats showed tendencies of neophobia to the sour tastes of citric, ascorbic (Miller & Holzman, 1981a) and HCL acids (Miller & Holzman, 1981b), despite the lack of ecological significance for sour tastes to the rat in its natural habitat. In tests of the hypothesis that reduction in neophobia would occur more readily to less ecologically relevant than to more ecologically relevant stimuli, Miller & Holzman (1981b) found that neophobia to salty and sour solutions was more readily attenuated through preexposures than was neophobia to sweet and bitter solutions. When rats were preexposed to three dissimilar novel tastes, reductions in neophobia occurred to salty (NaCl) and to sour (HCL) but not to sweet (sucrose) and bitter (quinine) solutions. These results supported the ethological explanation that neophobia was directly proportional to ecological relevance. Taste-aversion conditioning to all four tastes after preexposures, however, did not support the claim that neophobia was based on ecological relevance and indicated that separate mechanisms underlie neophobia and conditioned taste aversion (e.g., Hankins, Garcia, & Rusiniak, 1973). The failure for preexposure to ecologically irrelevant tastes to affect their potential for association with conditioned taste-aversion argues against the ethological explanation that neophobia evolved primarily as a defense against poisoning. These findings did not confirm a relationship between neophobia and potential ecological dangers or nutritional needs.

Species-specific neophobia to particular novel visual cues has also been interpreted as innate (e.g., Blest, 1957). Coppinger (1969), however, argued that there may be an innate tendency to reject novelty that is not related to a specific visual pattern (see also Hogan, 1965). Coppinger fed wild-caught blue jays a monotonous or a varied diet of sunflower seeds, mixed wild bird seed or pigeon pellets. In testing, he presented the birds with several neo-tropical butterfly species and insects after he had compared the shape, color, size and patterns of the experimental stimuli with those species within the range of the blue jays which resembled the experimental stimuli. There were significant differences between birds' reactions to different insects and in their responses to a specific novel insect depending on their training diet. In general, birds preferred a familiar diet. Rejection of the novel insect ranged from attack to active fleeing and alarm behaviors. Coppinger reported that response to the novel insect reflected an interaction between the novel pattern and the previous dietary experience of the animal.

The determining properties of salience- i.e., specific chemical properties of the tastant, the intensity or concentration of the solution, and the organism's prior history with the solution (e.g., Kamin, 1969)- bear strong resemblance to foregoing explanations for approach-avoidance behaviors to stimuli along the novelty continuum. Miller and Holzmans' findings (1981a, 1981b) suggest that salience is not phylogenetically predetermined, but arises from an ontogenetic organism-environment interaction.

IB. Variables in Ingestional Neophobia

Ingestional neophobia may be evoked by the novel appearance of an object, a novel taste in a familiar-appearing object, combinations of novel and visual taste cues, changes in the food container or in its location, changes in the eating environment, or novelty of the food presenter.

Effects of Novel Visual Cues

Although exploration of surroundings is typical behavior for wild rats, they tend to avoid unfamiliar objects placed into their cages (Chitty & Shorten, 1946). Barnett (1958) observed feeding interruptions in groups whose food was served in an unfamiliar tin in a new location and in groups whose food was served in the familiar tin in the familiar location but had an unfamiliar object placed in the cage. In Coppinger's (1969) research on reactions of blue jays to novel insects, he noted that an unfamiliar appearing stimulus may elicit alarm calls, expressions of fear and attempts to increase the distance between itself and the stimulus. Alarm reactions and escape responses in quail (Martin & Melvin, 1964) and young turkeys (Schleidt, 1961a, 1961b) appear to be based on the aversiveness of novelty in certain visual stimuli (c.f., Domjan & Burkhard, 1982).

Neophobia to visual cues has been explained as a function of the degree of contrast between the object and its background (Cott, 1940) and as species-specific avoidance of particular colors or patterns, independent of background color (Smith, 1975; Caldwell & Rubinoff, 1983). Roper (1990) found a relative aversion to red prey in chicks rather than an aversion to novel colors or to prey whose colors contrasted with the background. Chicks received either preexposure to red and brown cage background linings or no preexposures during training, then were presented with novel red or brown mealworms on red or brown backgrounds. Chicks who received no preexposures to the colors preferred novel brown to red mealworms on white flooring (Experiment 1) and on either background color in testing (Experiment 3a). Preference for brown mealworms could be reversed by rearing chicks in red cages (Experiment 2b), but not by preexposing them to red chick crumbs (Experiment 2a). The finding that the color red is inherently aversive to chickens runs counter to the fact that avians are attracted to many fruits and berries that are red (e.g., Rothschild,

1985) unless an argument can be made for failure to generalize between prey classes. The contrast hypothesis did not explain preference by the nonpreexposed group for brown mealworms independent of background color during testing. Chicks who were preexposed to the background colors during training preferred the novel mealworm whose color contrasted with the background color in testing (Experiment 3b). Thus, these findings demonstrated that the species-specific aversiveness of certain colors may be subject to modification based on preexposure to the type of color and to the degree of contrast between prey and background colors.

Effects of Novel Taste Cues

Research has demonstrated taste/flavor neophobia in rats (Baker, Baker, & Kesner, 1977, Experiment 4; Barnett, 1956, 1963, 1975; Barnett & Spencer, 1953; Capretta, Petersik, & Stewart, 1975; Capretta & Rawls, 1974; Domjan, 1977; Domjan & Bowman, 1974; Domjan & Burkhard, 1982; Gentile, 1970; Green & Parker, 1975; Nachman & Jones, 1974; Navarick & Strouthes, 1969; Richter, 1953; Rzoska, 1953; Sheffield & Roby, 1950; Siegel, 1974; Singh, 1974; Shorten, 1954; Young, 1944), dogs (Maslow, 1932), guinea pigs (Miller & Holzman, 1981a; Warren & Pfaffman, 1959), gerbils (Miller & Holzman, 1981a), turtles (Burghardt & Hess, 1966), fish (Mackay, 1974; Miller, 1963), birds (Capretta, 1969, 1977;

Capretta & Bronstein, 1967; Coppinger, 1969, 1970; Hogan, 1965, 1966, 1971, 1973; Morell & Turner, 1970; Rabinowitch, 1968, 1969), rhesus monkeys (Weiskrantz & Cowey, 1963), and in humans (Beauchamp & Cowart, 1985; Beauchamp & Moran, 1984; Hollinger & Roberts, 1929; Kare & Beauchamp, 1985; Rozin, 1976, 1977). (See Domjan, 1976, 1977, & Rozin, 1976, for reviews).

Two-year-old children initially avoided novel-tasting foods even if the foods were highly palatable (Kare & Beauchamp, 1985; Rozin, 1976). Although preference for sweet taste is present at birth in humans (Beauchamp & Moran, 1982), the addition of a novel sweet taste to a familiar food or beverage that had been previously experienced only in unsweetened form reduced food acceptance in six-month-old infants (Beauchamp & Cowart, 1984). Two-year-old children whose mothers had never given them sweetened water showed less preference for sweetened water than did children whose mothers had previously given them sweetened water (Beauchamp & Moran, 1984). Two-year-old children for whom Kool-aid was a novel flavor showed significantly greater neophobia to Kool-aid than did children for whom Kool-aid was familiar, regardless of the sweet taste (Beauchamp & Moran, 1984).

Effects of Combinations of Novel Visual/Taste Cues

Neophobia to novel-colored, flavored water may be greater than that to either cue alone (Beauchamp & Moran, 1984; Lett, 1984, 1980; Wilcoxon, Dragoin, & Kral, 1971). Pigeons preexposed to plain water showed greater neophobia to a novel flavor in colored water, such as blue salt water, than did pigeons preexposed to a novel flavor or to a novel colored water alone (Lett, 1980, Experiments 1 & 2). Quail preexposed to novel colored water showed greater neophobia to a novel flavor in colored water, such as red vinegar, than did quail preexposed to the novel flavor (Lett, 1984, Experiment 3). Shettleworth (1972) demonstrated through successive discrimination procedures that young chicks would learn to avoid an unpalatable water that was shocked or quinine-flavored, faster if the water was a novel color than if it was a familiar color.

Two-year-old children who received a combination of novel visual and novel taste cues consumed less of a solution than did toddlers who received a novel taste cue alone (Beauchamp & Moran, 1984, Test 3, Day 3). Toddlers were presented unsweetened or sweetened cherry Kool-aid. Intake was measured and related to prior experience with sweetened Kool-aid. To subjects with prior experience with sweetened Kool-aid, the unsweetened Kool-aid provided a novel taste cue only, the lack of sucrose. Those subjects drank significantly less unsweetened Kool-aid than sweetened Kool-aid. To subjects with no prior experience with sweetened Kool-aid, both sweetened and unsweetened Kool-aid solutions provided combinations of novel visual, red color, and novel taste, cherry flavor and sucrose cues. Those subjects also drank significantly less unsweetened than sweetened Kool-aid. However, those subjects that received a combination of novel visual and taste cues drank less Kool-aid overall, sweetened or unsweetened, than did subjects who received a novel taste cue alone, that is, for whom Kool-aid was familiar.

Effects of Novel Contextual Cues

Neophobia also occurs to a familiar food stimulus in a novel environment, form or container in rats (Barnett, 1958; Beck, Hitchcock, & Galef, 1988; Braveman, 1978; Braveman & Jarvis, 1978; Chance & Mead, 1955; Chitty, 1954; Kopp & Bourland, 1972, c.f. Mitchell, Kirschbaum, & Perry, 1975; Mitchell, 1976; Mitchell, Kirschbaum, & Perry, 1975; Mitchell, Scott, & Williams, 1973; Scott, 1946; Yerkes, 1913) and chicks (Franchina & Dyer, 1989). Exploratory behavior generally occurs to a new environment, but avoidance occurs to relatively minor environmental changes such as novel noises, odors and containers. Barnett (1975) reported field studies by Chitty (1954) which showed that wild rats avoided food and nearby, established pathways for days when their food was placed on a novel object. Laboratory studies have shown that a wild rat will refuse familiar food for several days if the food is presented in a novel container placed in a new location (Barnett, 1958). Even an empty, novel container placed in the wild rat's cage will interrupt feeding patterns (Barnett, 1958).

Hogan (1965) observed that even small changes in the chick's environment, such as locating the cage in another part of the experimental room, produced large and significant changes in general activities such as moving, pecking, preening, sleeping, sitting and shrill calling, whereas relatively large changes in deprivation levels produced very small or insignificant changes. Novel background color has been shown to inhibit feeding in chicks (Roper, 1990, Experiment 3a, p. 469). Chicks who were reared in standard grey cages with white floors and fed blue-dyed crumbs, failed to peck at or eat any mealworms, red or brown, during testing when the novel colored prey were presented on novel background floor colors, red or brown. Novelty of coloration was aversive to chicks given a choice of novel prey with a familiar or novel color. Chicks fed blue crumbs and reared in red or brown backgrounds during training, preferred, during testing, novel mealworms of the same color, red or brown, as their rearing environment (Roper, 1990, Experiment 2b).

Cross-modality contrast effects (e.g., Mitchell, Kirschbaum, & Perry, 1975; Mitchell, Winter, & Moffitt, 1980; Sheldon, 1969), and the contrast effect (Kurz & Levitsky, 1982; Lubow, Rifkin, & Alek, 1976), refer to the enhancement of neophobia to a novel stimulus in a familiar environment over that in a novel environment. Studies of novelty contrast effects emphasize the distinction between relative novelty and absolute novelty (Kurz & Levitsky, 1982; Lubow, Rifkin, & Alek, 1976; Mitchell, Kirschbaum, & Perry, 1975; Mitchell, Winter, & Moffitt, 1980; Sheldon, 1969). Relative stimulus novelty refers to the novelty of the stimulus compared to the novelty of other stimuli in the test environment. Absolute stimulus novelty refers to the novelty of the stimulus compared to stimuli of the same class in the prior experience of the subject independent of the test environment. The novelty contrast effect demonstrates that relative stimulus novelty is more important than absolute stimulus novelty (Lubow, Rifkin, & Alek, 1976) in neophobia. The cross-modality effect posits that neophobia to a novel stimulus is greater if all the other stimuli in the test situation are familiar (Mitchell, 1976, 1978; Mitchell, Scott, & Williams, 1973; Mitchell, Winter, & Moffitt, 1980; Sheldon, 1969). The pattern of results predicted by a novelty contrast theory would show greater neophobia to familiar (F) or novel (N) stimuli-environment combinations, respectively, in the following descending order of facilitatory effects: FN > NF > NN > FF

(Lubow, Rifkin, & Alek, 1976). Novelty contrast effects have been demonstrated in taste (Mitchell, Yin, & Nakamatsu, 1980), olfactory (Lubow, Rifkin, & Alek, 1976, Experiment 2) and contextual stimuli in rats (Mitchell, Kirschbaum, & Perry, 1975) and discrimination learning in children (Lubow, Rifkin, & Alek, 1976, Experiment 1).

The cross-modality effect has been demonstrated to food and contextual stimuli. Rats showed more neophobia for novel-tasting solution when tested in a familiar environment than in a less-familiar one (Mitchell, Yin, & Nakamatsu, 1980). Rats showed more neophobia for a novel complex of contextual stimuli which consisted of novel-shaped food containers, variation in levels of grain coarseness which had been placed in novel locations, after 25-days habituation than after 10 days of habituation to the test context (Mitchell, Kirschbaum, & Perry, 1975).

Finally, preexposure to a variety of novel contexts reduced neophobia to a novel tasting solution (Braveman, 1978, Experiment 3). Rats who received a familiar-tasting solution in various novel environments showed less neophobia to a novel saccharin solution in their home cage than did rats preexposed to restricted environments (Braveman, 1978).

Effects of Novelty of Presenter

The familiarity of the presenter of ingesta may increase the probability of approach behavior and ingestion.

Evidence suggests that the presence of adult rats at a food site when rat pups are ready to begin feeding on solid food is the most important factor influencing the pups' choice of initial diet (Galef, 1977; Galef & Clark, 1971a, 1971b). Hogan (1966) reported that all mother-reared chicks accepted a novel mealworm presented by the mother-hen, but only ten percent of socially-isolated chicks ate novel mealworms presented in a watchglass (Hogan, 1966). In chicks, acceptance of a novel food from a familiar presenter increased the likelihood of subsequent food acceptance. Chicks who ate the first mealworm offered by the mother-hen showed a high probability of eating subsequent mealworms, whereas those who did not eat the first mealworm presented by the mother hen had a low probability of ever eating a mealworm (Hogan, 1965).

The mother's role as deliverer of food during early feeding experiences makes her presence a familiar social cue for eating (Rozin, 1990a). The mother can be a direct social influence in transmission of food preference. She creates the feeding atmosphere and provides social exchange during the meal (Rozin, 1990a). The mother's presenting the food can be seen as an important factor in food acceptance because the familiarity of the presenter may increase the probability of the organism's approach behavior and ingestion of the food.

The occasion of a novel food-presenter in the eating context may constitute a novel stimulus with visual, olfactory, and perhaps auditory characteristics which may affect food acceptance. For humans, food acceptance patterns may reflect a complex integration of food cues in the social context of eating and the physiological consequences of ingestion (Birch, 1990a). Evidence suggests that acceptance of a novel food from a familiar presenter increases the likelihood of subsequent food acceptance. Human infants are less likely to accept a novel food from a novel presenter than from their mother. For example, Harper and Sanders (1975) had the mother or a friendly adult visitor deliver a novel food, a blue-colored tortilla filled with ham and cheese, a macadamia nut or a date, to a 14- to 20-month-old toddler or a 42- to 48-month-old preschooler. Children were more likely to put a novel food into their mouths when the food was offered by their mother than by a stranger, regardless of the gender of the child or the stranger.

Differences in Neophobia over Ontogeny

Flavor neophobia has been directly related to age in rats (Baker, Baker, & Kesner, 1977, Experiment 4; Misanin, Blatt, & Hinderliter, 1985), in primates (Itani, 1958, c.f. Birch & Marlin, 1982) and in human toddlers (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987). Rat pups (23-days-old) did not demonstrate neophobia to a novel grape fluid, whereas adult rats did (Baker et al., 1977). In another experiment, greater neophobia was observed in mature rats than in weanling rats (Misanin, Blatt, & Hinderliter, 1985). Japanese macaques younger than three years-of-age showed less neophobia to a novel food than did older animals (Itani, 1958, c.f. Birch & Marlin, 1982). Research has revealed evidence of developmental changes in ingestional neophobia in humans, but a clear pattern has not yet emerged. Desor, Maller, and Andrews (1975) reported that intake of moderate solutions of novel saline solution did not differ over that of plain water among newborn infants. In similar comparisons of infants between 80- to 200-days, Vasquez, Pearson, and Beauchamp (1982) found that indifference in the youngest age group (60- to 119-days) changed to preference for salty solution at about four months-of-age. Data suggest that newborns are insensitive to salt, and that sensitivity to salt emerges at about four months-of-age (Beauchamp, Bertino, & Engelman, 1985). However, by age two, children strongly rejected salty solutions over plain water (Beauchamp, 1981) as did most adults (Bertino, Beauchamp, & Engelman, 1983). Data on ingestional neophobia for human infants younger than 14-months are scarce. The high incidence of accidental poisoning during the age period prior to preschool has been interpreted as an indication of minimal neophobia for foods prior to age three (Birch & Marlin, 1982). Harper and Sanders (1975) found no reliable age-related effects in neophobia to novel foods between 14- to 20-month- and 42- to 48-month old subjects. Similarly, Beauchamp and Moran (1984) found no correlation between age and reduced intake of novel solutions in two year olds. In comparisons of two- to five-year-olds, however, Birch et al. (1987) found reliably greater neophobia to novel foods among the younger subjects in their sample of children between 23- to 69-months of age. In fact, Birch et al. noted that four of the six children in the youngest age group were eliminated because they were so uncooperative or neophobic that they refused to look at or taste the novel stimuli.

The Moss-Harlow learning design (Moss & Harlow, 1947) has been used to test developmental changes in preferences along the novelty-familiarity continuum by testing neophilia and neophobia against the predictions of reinforcement theory in monkeys (Moss & Harlow, 1947) and children (Cross & Vaughter, 1966; Fisher, Sperber, & Zeaman, 1973; House & Zeaman, 1958; Grabbe & Campione, 1969; c.f., Zeaman & Hanley, 1983). Zeaman and colleagues have found that two-year-olds show a preference for the novel stimulus over the previously rewarded, familiar stimulus. Between ages two and five, preference for novel cues changes to preference for the familiar cues. The developmental change in preference for novel cues to preference for familiar cues that occurs at around mental age four to five years-of-age has been called the Moss-Harlow Effect (Cross & Vaughter, 1966; Fisher et al., 1973; Grabbe & Campione, 1969; House & Zeaman, 1958; c.f., Zeaman & Hanley, 1983). In sum, in infrahuman studies, neophobia to novel foods was not observed in the younger organisms but was observed in the older, adult organisms. Data support age differences in neophobia to novel flavors in humans, but has not, as yet, yielded a comparable monotonic pattern.

II. Preexposure

Preexposure to an ingestible (Domjan, 1976; Siegel, 1974; Tarpy & McIntosh, 1977), or an odor (Caza & Spear, 1984; Smith, Kucharski, & Spear, 1985; Wigal, Kucharski, & Spear, 1984; c.f., Spear & Molina, 1987), attenuates neophobia to that ingestible.

IIA. Preexposure and Testing with the Same Ingesta

Preexposures in early feeding experiences influence later food acceptance. Research with newly-hatched chicks (Capretta, 1969), zebra finches (Rabinowitch, 1969), gull chicks (Rabinowitch, 1968), puppies, kittens and mynah birds (Kuo, 1967) has shown that early feeding experiences influence later food preferences. For example, chicks given a choice test preferred a familiar food over an unfamiliar food (Rabinowitch, 1968). A notable effect of early experience was the finding that zebra finches reared on canary grass chose familiar canary grass over naturally-preferred millet when millet was novel (Rabinowitch, 1969).

Prenatal and early postnatal experiences with novel tastes produce strong and lasting preferences for the preexposed cue (Capretta, 1977). Capretta and Rawls (1974) preexposed rat pups to garlic during the later gestation/nursing period and/or during the early postweaning period and measured the acceptance of this flavor when the pups were adult rats. Adult rats who had been preexposed to garlic during the nursing period showed less neophobia than did the non-preexposed group or the group pre-exposed during early postweaning. Adults who were preexposed to garlic in nursing and early postweaning periods showed the least neophobia. Birch and Marlin (1982; Pliner, 1982) reported that food preferences for novel tastes increased as a function of frequency of taste-exposure. Birch and Marlin (1982) gave two-year-old children 0-,2-,5-,10-,15-or 20-taste exposures to five initially novel cheeses or fruits. They found that preferences increased with number of taste exposures.

IIB. Preexposure and Testing with Different Ingesta

Neophobia to a novel taste may be attenuated after prior exposure to other, dissimilar novel tastes (Braveman &

Jarvis, 1978; Miller & Holzman, 1981b; Siegel, 1974). Siegel (1974) reported that rats who were preexposed to coffee or vinegar drank more of a second novel taste, vinegar or coffee, respectively, than did non-preexposed animals. Preexposure to a series of novel flavors reduced neophobia to a different novel test solution more than did preexposure to a single flavor (Braveman & Jarvis, 1978; Capretta, Petersik, & Stewart, 1975; Miller & Holzman, 1981b; Tarpy & McIntosh, 1977). For example, rats that were preexposed to a series of novel-flavored solutions, saccharin-, lemon-, coffee-, or almond-flavored water, which differed from the novel salt-flavored test solution showed reduced neophobia to the test solution (Braveman & Jarvis, 1978, Experiment 1).

Neophobia may be reduced by mere exposure to the edible without ingestion in chicks (Franchina & Slank, 1989) and in human infants (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987). Preexposure to the odor of alcohol has been shown to increase the consumption of ethanol by infant rats without any preexposure to the taste of ethanol (Molina, Hoffmann, & Spear, 1985; Molina, Serwatka, & Spear, 1984; Molina, Serwatka, Spear, & Spear, 1985; Serwatka, Molina, & Spear, 1986; c.f. Spear & Molina, 1987).

Preexposure to novel visual stimuli or to combinations of novel visual and novel taste stimuli enhances preference for the novel visual cues (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987). Indeed, preexposure to taste cues when they are combined with visual cues is more effective in reducing neophobia than is preexposure to visual cues alone in chicks (Franchina, 1991) and human infants (Birch et al., 1987). However, experience with novel visual cues alone was not sufficient to enhance preferences for novel taste cues in children (Birch et al., 1987). Birch et al. (1987) presented seven novel fruits to children between two- and five-years-of-age, to either look at or to taste over 5- to 15-exposures. Only experience with novel taste enhanced preferences for those tastes (Birch et al., 1987; Birch & Marlin, 1982).

Preexposure effects have been explained by the Learned-Safety Hypothesis (Kalat & Rozin, 1973) and by the Learned-Noncorrelation Hypothesis (Best, 1975; Kalat, 1977). According to the Learned-Safety Hypothesis, an organism limits intake of a novel flavor until it learns an association between the novel characteristic and the absence of negative postingestional consequences. The Learned-Noncorrelation Hypothesis explains preexposure effects as a learned noncorrelation between the ingestive and a negative postingestional consequence (c.f., Miller & Holzman, 1981a, 1981b). For example, if an organism were preexposed to a particular food over several trials, with no negative postingestional consequences, then experienced an illness following ingestion of that food, the organism might not form an association between the illness and the familiar food. The failure to associate the illness and the food could be explained as a learned noncorrelation because the organism had had prior experience with this food in preexposure without negative postingestional consequences or because the organism associated the illness with a novel cue or event.

Preexposure effects may also involve habituation. Habituation reflects changes in the S-R system that operates as a reflex arc between sense organs and muscles involved in affecting the response (Groves & Thompson, 1970; Thompson, Groves, Teyler, & Roemer, 1973). Changes in the nervous system occur such that sensory neural impulses are not relayed to motor neurons (Domjan, 1982). Thus, habituation results in a decrease in the stimulus' elicitation of a response.

IIC. <u>Differences in Preexposure Effects over Ontogeny</u>

<u>Preexposure to a Single Ingestible</u>

The attenuating effects of preexposure on neophobia are age-dependent (Capretta, Petersik, & Stewart, 1975, p. 691; Misanin, Blatt, & Hinderliter, 1985). In two experiments, Capretta (1969) offered newly hatched chickens two novel-colored foods or two novel-tasting foods, over two consecutive 24-hour periods. Although the chicks ate more of the second food presented as a function of their age and growth over five to 12 days posthatch, they preferred the food to which they had had early preexposure (Capretta, 1969). Capretta's data suggest that the timing of experience in development has a stronger influence on later food preference than does the magnitude of intake over exposures of equivalent duration. In a replication of findings of age-dependency in flavor neophobia of weanling and young adult rats (Misanin, Guanowsky, & Riccio, 1983), Misanin, Blatt, and Hinderliter (1985) expanded their study to include old-age rats. Preexposure reduced neophobia significantly more in young than in old rats. In fact, after habituation, intake in old rats did not differ significantly from that of non-habituated controls.

<u>Preexposure to Varied Ingesta</u>

The effect of preexposure with varied novel flavors on taste neophobia is age-dependent in rats. Capretta, Petersik, and Stewart (1975) exposed immature and mature rats to a single solution or to three novel solutions and then tested neophobia to a different novel solution. Immature rats, exposed to the variety of flavors, showed less neophobia than did those who received restricted exposures. Mature rats, however, showed neophobic responses to the novel solution irrespective of preexposure conditions

(Capretta, Petersik, & Stewart, 1975).

Age-related differences in preexposure effects have not been documented in humans. Birch, McPhee, Shoba, Pirok and Steinberg (1987) offered two- to five-year-old children 5-, 10-,or 15-"look" or "look and taste" preexposures to seven novel fruits. Although ingestional neophobia was reliably greater among the younger subjects, no reliable age-related differences in preexposure effects on preferences were observed.

III. Human Food Acceptance

Human infants can discriminate tastes immediately after birth (Mistretta & Bradley, 1977). The typical newborn can see objects as far away as their mother's face during nursing. Thus, infants can establish eye contact, an integral part of the mother-infant social interaction (Stern, 1977) during the feeding situation.

IIIA. Factors in Human Food Acceptance

Food acceptance may be the result of positive factors that lead to the initiation and continuation of eating behavior and negative factors that lead to the avoidance of ingestion. Beauchamp and Cowart (1985) cite as positive factors, appetitive sensory attributes of the food stimulus, the organism's prior experience, beliefs and feelings about the food, hunger and nutritional state (Birch & Deysher, 1986; Fomon, 1974). Negative factors may be distaste, ideas of disgust toward the food, anticipated postingestional danger, classification of the food as inedible, satiation, repletion, and novelty (Birch & Deysher, 1986; Fallon & Rozin, 1983; Fomon, 1974; Rozin, 1976, 1977, 1990a; Rozin & Fallon, 1980, 1981; Rozin & Kalat, 1972). Children's preference can be positively or negatively influenced by the affect generated in the social context of eating (Birch 1990a, 1990b). Influences may become more complex as factors combine and interact. Food aversions of the family are associated with 35% of the food aversions in children aged two- to seven-years old (McCarthy, 1935). However, low correlations in food preferences between parent and offspring suggest that parental food preferences may not be the determinant of infant food preferences (Birch, 1980; Pliner, 1983; Rozin, 1990b; Rozin, Fallon, & Mandell, 1984).

IIIB. Effects of Novelty on Food Acceptance

Beauchamp and Moran (1982) reported that reduced intake of novel tastes occurred in infants as young as six months-of-age. Several studies have established evidence of ingestional neophobia in two-year old toddlers (Birch & Marlin, 1982; Birch, 1987). Ingestional neophobia in the feeding situation may limit the infant's opportunities to experience different foods. Children's food refusals and selectivity accounted for about 11 percent of the cases referred to one nutrition department over a four-year period

(Palmer & Horn, 1978).

IIIC. Developmental Differences in Food Acceptance

Since neophobia depends on novelty, which is dictated in part by prior experience, and since development is an experiential variable, one might expect changes in neophobia during development. The influence of preexposure to novel stimuli may depend on the timing of the preexposure experience in relation to the age of the organism. Changes may occur in affective responses to novelty as a function of preexposure to multiple sources of novelty in the feeding situation. Structural or functional changes in the organism may occur such that the detection of novelty is not the same at one time in ontogeny as it was at another.

Visual acuity in human infants approaches that of an adult at or about seven- to eight-months-of-age (Banks & Salapatek, 1983; Cornell & McDonnell, 1986). Myelinization of the optic nerve is complete by the 10th postnatal week, but the retina and fovea continue to mature until at least the 11th postnatal month (Atkinson & Braddick, 1982; McCarron, Morris, & Cole, 1982; Banks & Salapatek, 1983).

Salapatek (1975) noticed developmental differences in the way that infants make use of visual cues when they are presented a figure inside the contour of another. Newborn infants tend to focus only on the external contour. At two- to three-months-of-age, infants begin to notice and explore the inner contour. This finding complements Fantz' (1961, 1963) findings that around three-months-of-age, infants begin to distinguish schematic facelike forms from a form in which facial elements were scrambled. Infants show discrimination of maternal expressions as early as three-months-of-age; and discrimination increases over the second half of the first year when infants begin to seek information about others' feelings through social referencing (Haviland & Lelwica, 1987; Termine & Izard, 1988; Tronick, 1989).

Conclusions about infant vision from studies of stationery facelike forms may underestimate the infant's perception of human faces. Consistent with Salapatek's (1975) findings, Bushnell (1982) reported that infants at one- to two-months of age attended to changes in the external feature of a stationery compound stimulus but did not attend to changes in the internal elements. Surprisingly, the infants attended to internal and external elements when the former oscillated back and forth. Apparently, movement in people's faces facilitates the newborn's attending to the internal features as well as the outlines of faces.

When facelike forms are presented in motion rather than in a stationery format, neonates, nine-minutes-old, turn their heads to a schematic face but not to a featureless face or a form in which facial elements were scrambled (Goren, Sarty, & Wu, 1975). Field, Cohen, Garcia, and Greenberg (1984) found that 45-hour-old infants preferred to look at their own mother's face than that of another woman. Kagan (1971) has summarized the developmental changes in visual preferences in infancy from interest in the physical properties of forms, to preference for familiar schemata around two- to three-months of age, to preference for complex and novel forms that evoke interpretations at or about age one.

During the second half of the first postnatal year, infants in ambiguous situations demonstrate social referencing by regulating their behavior on the basis of their mothers' emotional reactions. Infants, 8-to 10-months of age, responded more favorably to the rapid approach of an unfamiliar person if the infant's mother greeted the stranger warmly than if the mother's greeting was neutral or negative (Campos & Stenberg, 1981; Feinman & Lewis, 1983). By about 12-months, the infant may use the facial expression of an unfamiliar person as a social reference. One-year old infants smiled and approached an unfamiliar robot toy when a nearby stranger smiled, but avoided the toy if the nearby stranger displayed a fearful expression (Klinnert, Emde, Butterfield, & Campos, 1986).

IV. Methodology in Studies of Food Acceptance

IVA. Operational Definitions of Food Acceptance

In studies of human subjects, food acceptance has been broadly defined as an organism's willingness to ingest a food (Beauchamp & Cowart, 1985). Riordan, Iwata, Finney, Wohl, and Stanley (1984), however, have proposed an operational definition of food acceptance as the opening of the child's mouth to receive a portion of food within three seconds after the portion is presented within one inch of the mouth (p. 329). Harris, Thomas, and Booth (1990) have defined two dimensions of positive food acceptance behaviors. Food acceptance was classified "eager" if the infant opened its mouth before the spoon of food was offered and as "positive" if the infant opened its mouth when the spoon of food was offered. Harper and Sanders (1975) operationally defined acceptance with a time sampling technique as the subject's placing the food in its mouth within one minute of grasping it (p. 208). Birch and Marlin (1982) used event sampling which scored tasting behavior if the child placed, or allowed the experimenter to place, the food stimulus on the tongue or in the mouth, even if the child spat out the stimulus.

Ingestional neophobia has traditionally been defined as the difference between ingestion of a novel food/drink at its initial presentation and ingestion of the same food/drink when it is familiar. Miller and Holzman (1981a) used intake to define neophobia operationally as the difference in the amount of an ingestible consumed over a fixed duration at initial exposure relative to that consumed over the same duration after consumption was at asymptote.

IVB. Measurement Approaches

Food acceptance has been measured by intake (Miller & Holzman, 1981a, 1981b), choice behavior (Beauchamp & Moran, 1984; Birch & Marlin, 1982; Rabinowitch, 1968, 1969; Rudy, Rosenberg, & Sandell, 1977), latency to ingest (Cole, Robbins, & Everitt, 1988; Mitchell, 1976), time sampling (Harper & Sanders, 1975), hedonic display (Braun-Bartana, Ganchrow, & Steiner, 1986; Duncker, 1938, p. 504; Ganchrow, Oppenheimer, & Steiner, 1979; Steiner, 1977, 1979a, 1979b; see Lipsitt & Behl, 1990, for a review), and taste reactivity (Braun-Bartana, Ganchrow, & Steiner, 1986; Grill & Norgren, 1978a, 1978b).

Intake measures compare amount consumed when the substance is novel to that after the substance has become familiar (Braveman & Jarvis, 1978; Miller & Holzman, 1981a, 1981b).

Choice tests typically involve simultaneous presentations of preexposed and novel stimuli. For example, Rabinowitch (1968) fed three groups of gull chicks three different diets. Choice was determined by which of two simultaneously presented foods elicited three consecutive pecks from the bird. In another choice test, Rabinowitch (1969) simultaneously presented two or three foods and measured total intake. Rudy, Rosenberg, and Sandell (1977) used a choice paradigm with rats and recorded choice as the percentage score, the amount of novel fluid drunk over total intake from two drinking tubes. Choice tests in humans differ with age of subject. An infant may be presented with bottles containing a solvent, usually water, and a tastant mixed with the solvent. Choice is measured as relative intake, the amount of each substance ingested during a 0.5 to 3.0 minute exposure period (Beauchamp & Cowart, 1985). Choice measures with solid foods have been employed with two-year-olds using carrots (Beauchamp & Moran, 1984), two- to six-year-olds using (un)salted beef stew or (un)sweetened spaghetti (Filer, 1978), and four- to eight-year-olds using (un)salted pretzels (Beauchamp, 1981). Birch and Marlin (1982) presented the two-year-old children with samples of two foods in clear plastic cups and recorded tasting order, amount consumed and any comments or ingestion behaviors of the child.

Latency measures the time to the first ingestive response to food or to complete a sequence of ingestive responses. For example, Mitchell (1976) installed a partition that confined the rat at the back of the cage. He recorded the latency for each subject to begin feeding after the partition was removed. Shettleworth (1972) placed a trough of blue water or clear water in the chick's compartment and measured latency to the first drink (Experiment 1) or peck (Experiment 2) of the water.

Harper and Sanders (1975) used a time sampling technique in which food acceptance was scored if the child put food in the mouth within one minute of grasping it, whether or not the child swallowed food after food was in his/her mouth.

Steiner (1979a), quoting Pfaffman's view (Pfaffman, Norgren, & Grill, 1977), characterized an organism's reaction to a sensory stimulus into three basic categories of behavior: 1) indifference or neutrality, 2) acceptance or approach, or 3) withdrawal or aversion. Measures of orofacial and gustofacial responses are based on the assumption that nervous system reactions to the hedonic dimension of sensation release motor behaviors that signal the organism's reaction to food-related stimuli.

Sweet, bitter and sour taste stimuli elicit oral and facial motor responses in newborn rabbit pups (Ganchrow, Oppenheimer, & Steiner, 1979), hatchling chicks (Braun-Bartana, Ganchrow, & Steiner, 1986), rats (Grill & Norgren, 1978a,b), and in newborn infants (Chiva, 1982; Steiner, 1973, 1977, 1979a, 1979b). Ganchrow et al. (1979) recorded orofacial expressions to a droplet of a taste solution placed medially on the rabbit pup's lips. Expressions elicited by various tastants delivered to the tongues of full-term neonates have been recorded by cinema, videotape or still photography (Steiner, 1977).

Steiner (1973,1977) demonstrated that gustofacial responses to distinct taste cues in cats and rabbits (Steiner, 1973) could also be observed in human neonates (Steiner, 1977). He argued that neonatal facial expressions to taste stimuli, sweet, sour or bitter, were non-verbal signals of acceptance or rejection. The gustofacial response of the neonate to a sweet stimulus is a marked relaxation of the face, often accompanied by a slight smile, an eager licking of the upper lip and sucking movements. Response to a sour stimulus is lip-pursing accompanied or followed by nose wrinkling and eye blinking. A bitter stimulus elicits an "arch form opening of the mouth with the upper lip elevated, the mouth angles depressed, and the tongue protruded in a flat position" (p. 175). This behavior is often followed by spitting or preparatory vomiting movements. Adult observers, ignorant of the stimulus conditions, have interpreted records of the facial expressions of sweet stimulus as enjoyment and the facial expressions of bitter as aversive (Steiner, 1977).

Chiva (1982) investigated the relationship between taste and facial expression in a longitudinal study of 40 infants from birth to age two. He proposed three phases in the evolution of the gustofacial response to taste stimuli from birth to 16 months of age in human infants. According to Chiva, Phase 1, from birth to around six months, is reflexive. The second phase, from nine to 14 months of age, is more modulated and can be initiated by more dilute taste stimulation. During the second phase, strong stimulation still results in the same gustofacial reaction as in the first phase, but the reaction is not directed at any person in particular. The third phase emerges at about 16-months-of-age and involves a deliberate communicative response. As in the second phase, a taste stimulus elicits an initial expression, but the child will exaggerate the expression and seek a target audience. The child will then repeat the expression accentuating a positive or negative response to food (Chiva, 1982). Conclusions from Chiva's research concerning developmental shifts in gustofacial expression, however, may be restricted by the limited information of the report. Unfortunately, the author did not specify the methods by which the data were obtained. For example, the frequency, duration, length of intervals between and total number of observations were not supplied. The chararacteristics of the observer(s) (e.g., familiar or novel adults), operational definitions of facial responses or means by which observations were recorded and analyzed were not reported. No data were offered concerning the reliability of the discrimination of expressions between judges. Details of characteristics of food stimuli, such as its novelty or familiarity, whether or not subjects received the same stimuli over repeated presentations or if all subjects received the same stimuli, were not stated. Mechanisms for how a purported shift in the gustofacial response, that is, from reflex to social response, might have occurred, were not discussed (see also Birch, 1987, p. 182). Chiva's data are consistent, nonetheless, with other research of taste evaluations in infants which suggests that stability in taste response in humans is evident as early as six months-of-age (Beauchamp & Moran, 1984).

Grill and Norgren (1978a, 1978b) combined measures of behavioral display, called taste reactivity, with measures of gustofacial responses to taste cues in rats. Grill and Norgren's measures expanded the indices of mimetic responses, movements of orofacial muscles, to include behaviors such as chin rubbing, head shaking, face washing, forelimb flailing, paw pushing (1978a, pp. 270-273), paw wiping and rearing (1978b, p. 289). Videotapes of rats receiving tastants through intraoral fistulae were analyzed frame by frame for evidence of stereotypic behavioral patterns (Grill & Norgren, 1978a,b). Subsequent studies like those of Braun-Bartana, Ganchrow, and Steiner (1986) have included measures of behavioral display such as the chicken's walking away from the stimulus container, with indices of hedonic display, such as head shakes, beak claps, pecks, beak wipes, and gaping.

In overview, researchers of infrahuman food acceptance patterns have made a gradual transition in measurement techniques from intake, to latencies to ingest, to measures of hedonic display, to behavioral indices of approach or withdrawal. This broadening of the range of behavioral measures has begun to emerge in the human food acceptance literature. For example, behavioral indices of food rejection were recorded by Rozin, Hammer, Oster, Horowitz, and Marmora's (1986) study of children's reactions to rejected substances. Responses of subjects aged 16-months to five years included rejection behaviors such as no contact, touching, smelling, food brought to mouth, and spitting the food out.

IVC. The Two-Stage Model of Ingestion

Food and drink present compound/complex stimuli which consist of visual, taste, tactual, thermal, textural and olfactory cues. The Two-stage Model of Ingestion proposes that distal information from visual or olfactory cues control approach and the initiation of ingestion and proximal information from taste and gastric cues influence the continuation of ingestion (Garcia, Hankins, & Rusiniak, 1974; Brett, Hankins & Garcia, 1976; Rusiniak, Hankins, Garcia, & Brett, 1979). In the approach stage, visual and olfactory cues may facilitate approach by virtue of their familiarity and prior associations (Domjan, 1976; Shettleworth, 1972). In the consummatory response stage, the characteristics of gustatory, thermal and textural cues may influence the maintenance of ingestion (Brett, Hankins & Garcia, 1976).

Research with avians and humans has supported the two-stage model. Preexposure to visual cues facilitated the initiation of ingestion (Capretta, 1969; Franchina & Slank, 1989) and reduced visual aversion effects (Martin & Bellingham, 1979). Preexposure to novel-colored and novel-flavored water facilitated intake in chicks more than preexposure to novel flavored water did alone (Franchina & Slank, 1989). Two- to five-year-old children who received visual and taste preexposures to pieces of novel foods such as dried figs, papaya or sugar palm, showed enhanced preference ratings for those foods over the nonpreexposed controls (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987). Children who only looked at the novel foods during preexposure, increased visual preference, but not taste preference. Preexposure to visual cues promoted initiation of ingestion and reduced visual aversion. However, preexposure to visual cues did not affect taste preference.

Preexposure with taste cues was necessary.

These results for intake performance suggested that ingestion involves the role of distal cues such as those from visual stimulation and proximal cues such as those from taste. These cues may act in separate stages for initiation and consummatory behaviors, as the two-stage model would suggest. However, intake measures may confound the approach and consummatory phases of ingestion and prevent separate evaluation of the roles of context and taste cues. If distal information from olfactory, visual and auditory cues control approach behavior, and those cues antedate the influence of proximal information from taste cues, then a latency index might facilitate the separation of effects of distal and proximal cues. Rusiniak, Hankins, Garcia, and Brett (1979) have measured rats' latencies to lick a test solution, and Shettleworth (1972) and Franchina, Johnson, and Leynes (1993) have measured chickens' latencies to touch or to the first drink of a test solution, respectively, as measures of approach. Franchina et al. used latency to complete ten drinks of the test solution as measures of continuation of ingestion, characteristic of the consummatory phase of the two-stage Model.

V. <u>Research Design</u>

The purpose of the present study was to investigate 1) ingestional neophobia as a function of distal and proximal sources of stimulus novelty, alone and in combination, 2) developmental differences in ingestional neophobia in human infants of two ages, and 3) the utility of the two-stage model of ingestion in understanding the role of novel cues in food acceptance.

In this experiment infants or toddlers received a novel or a familiar food from a novel or familiar presenter. The measures of performance were the time elapsed (latency) to the first bite and then to the second bite of food, frequencies of gustofacial expressions, behavioral indices of food rejection, such as spitting out the food, pushing the food away and upper body flexion, and percentage intake.

According to the two-stage model, characteristics of the presenter, such as visual, olfactory and auditory cues, constitute distal cues. Characteristics of the food, such as taste, olfaction, appearance, texture and temperature, constitute proximal cues. Neophobia to novel presenter and novel food cues was measured with latencies to the first and second bites. Since neophobia is presumed to reflect the aversiveness of novelty, evidence of such aversiveness was sought in gustofacial responses, behavioral indices of food rejection, and percentage intake. Based on the previous research, the hypotheses of the previous study were:

Hypotheses

Hypothesis 1

Duncker (1938) reported that infants attended to distal presenter cues before they attended to food cues. Harper and Sanders (1975) found that children were less likely to eat a food from a novel than from a familiar presenter. On the basis of these data and the two-stage model, latencies to the first bite should be longer in the novel than in the familiar presenter condition.

Hypothesis 2

Studies of taste-preexposures showed that novel tastes produce a reluctance to eat (Birch & Marlin, 1982; Pliner, 1982). In this study, if the first bite provided novel taste cues, then latency to the second bite should be longer than if the first bite provided familiar taste cues.

Hypothesis 3

Beauchamp and Moran (1984) produced evidence that suggested greater neophobia to combinations of novel visual and taste cues than to a novel taste cue alone. Therefore, combining novel presenter and novel taste cues should produce longer latencies to the second bite than will either novel cue alone.

Hypothesis 4

Based on Chiva's (1982) data, toddlers are more likely to exhibit aversive gustofacial responses to novel taste cues than are younger infants. Thus, after the first bite of food, aversive gustofacial responses should appear more frequently in toddlers than in infants.

METHODS

Subjects

Subjects were 32 infants, 6- to 12-months old, with a mean age of 10.1 months, and 32 infants, 13- to 24-months old, with a mean age of 18.1 months. Gender (31 male, 33 female) and racial (59 Caucasian, 5 non-Caucasian) characteristics were allowed to vary unsystematically across groups. Data from 13 of the original 77 subjects were discarded for the following reasons: the subject had never fed him/herself finger foods (7), an error in experimental procedure (5), or the subject had had prior problems with their digestive tract (1).

Subjects were recruited from local day-care centers in southwestern Virginia. A cover letter to parents (Appendix A), which described the study and requested permission for their child's participation, accompanied a statement of informed consent. (Appendix B). To assess the child's prior experience with food stimuli, parents completed a checklist (Appendix C) of common foods typically given to infants.

Design

Subjects in each age group were randomly assigned to two food and two presenter conditions using a 2 Age (Infant vs. Toddler) X 2 Food (Novel vs. Familiar) X 2 Presenter (Novel vs. Familiar) design. The novel and familiar foods for each subject were based on the parents' responses on the food checklist. Criterion for a familiar food was any prior ingestion. Criterion for a novel food was no known prior exposure. To match food stimuli across novel and familiar food conditions, whenever possible, the same food stimulus that was familiar to one subject was chosen as the novel food stimulus for another subject. The familiar presenter was the person who typically fed the child at the day-care center. The novel presenter was a research team member. All presenters were female.

Materials

Materials for data collection were a stopwatch, videocamera, VCR and television screen.

Food stimuli were cubes of boiled carrots, yellow, butternut or zucchini squash, white or sweet potato, blocks of red or apricot Jello, canned pear, Ritz crackers, gingerbread or soft oatmeal cookies, each measured into one-half cup portions. Food stimuli were prepared by the experimenter or by the chef at Donaldson-Brown Conference Center of Virginia Tech.

The vegetables were peeled and cut into one-half inch cubes and steamed without condiments. The Jello package recipe was reduced by one-half cup cold water, and in some cases, apricot nectar was substituted for the one-half cup of cold water. The food stimuli were preweighed to the nearest gram. All food was kept chilled during transport and vegetables were warmed by microwave at the center immediately prior to serving. Jello was served at room temperature. When the food stimulus was served on a plate, the food was transferred to a plate typically used at the subject's day-care center.

Procedure

Most of the day-care centers fed the younger infants, up to 12 months, individually on demand when the infants woke from their morning nap, around 10:30 a.m. Toddlers were typically fed in a group around 10:30 a.m. Children were seated together in high-chairs, at a table with built-in seats or in chairs at a small table. Center personnel typically fed two or three infants at a time.

On a preset date for data collection, the research team arrived at the center one-half hour beforehand. Prior to feeding time, the experimenter and the research assistant entered the infants' or toddlers' room and reviewed the experimental procedures with the staff. The research assistant participated in the initial conversation with the staff to establish her role as a friendly adult, but she did not make overtures toward the children. The experimenter assembled the camera in the feeding area. The research assistant set up the food for serving.

At feeding time, the day-care attendant placed the subject in the typical feeding location, applied a bib to the subject when appropriate, washed the subject's hands and cleared the feeding tray. Subjects assigned to the same presenter condition were videotaped individually or in pairs. Novel and familiar presenter order was counterbalanced across data collection periods.

At the start of testing, the experimenter began videotaping the subject for at least ten seconds to record facial expressions prior to stimulus presentation. A test trial started when the presenter placed the food stimulus directly in front of the child. The presenter's expression was pleasant. The presenter said, "Here is some name of food. Would you like to try some?" The experimenter activated a stopwatch concurrently with food placement.

Time sampling procedures used in Harper and Sanders (1975) were adapted to record latencies to the first (B1) and second bites (B2) from the videotape. The measures of food acceptance were times to the first two bites of food. Latency to the first bite was the time elapsed between starting the stopwatch at initial food placement in front of the child and mouth closure. Mouth closure was indicated when the child's lips, teeth, or gums touch within five seconds of the food's being deposited in the mouth (Iwata et al., 1982, p. 310). Temporarily accepted food was recorded as a bite even if it was ultimately spit out or extruded.

Maximum time-limit for occurrence of the first bite was 120 seconds.

If the child did not pick up a piece of food and initiate the first bite after 120 seconds, the presenter placed one cube of the food on the child's lips. If the child accepted the assisted taste, then a latency of 120 seconds was recorded to the first bite. Latency to the second bite was measured from the time of mouth closure for the first bite, or assisted taste, to the time of mouth closure for the next bite. If the child did not initiate the second bite within 120 seconds, a latency of 120.0 seconds was recorded for the second bite. If the child refused the assisted taste, and never sampled the food stimulus, then a latency of 240 seconds was recorded to the first bite, and latency of 120 seconds was recorded to the second bite. Maximum trial duration was 240 seconds.

Food which remained uneaten after the test trial was removed from the tray and weighed to the nearest gram for a measure of intake.

All dependent variables except intake were measured from videorecordings by raters. As indicated on the Rating Sheet (Appendix D), measures were obtained for latency to the first touch, latencies to first and second bites, frequency of avoidance behaviors and positive and negative facial expressions observed during the pretrial interval, from food stimulus presentation to first bite, and from the first to second bite. Frequency of the following avoidance behaviors were noted in each interval: pushes food away, spits out food, flexor response upper extremeties. The latter behavior generally appears as an arched back, elbows bent and next to chest, the hands raised toward the shoulders and the legs extended.

Raters also classified and rated the intensity of gustofacial expressions, using a modified form of the checklist for coding facial expressions developed by Kring, Smith, and Neale (1989). Facial expressions were rated on a 9-point Likert scale with five as neutral and positive and negative as the endpoints. Positive and negative polarities were counterbalanced over high and low ends. Intensity and duration of facial expression was measured by the percentage with which each expression was observed during an interval. Raters counted the frequency with which each expression was emitted during an interval.

Data Analysis

The dependent variables were latencies to the nearest second, gustofacial responses, frequencies of behavioral indices and amount eaten. Gustofacial responses were measured by a two-step procedure. First the rater counted the frequency of each facial expression (E) during each designated time frame. A ratio was formed of the frequency of a particular expression over the total number of facial expressions (TE) during that time frame. Finally, the ratio was multiplied by 100 to produce a percentage score (PS): [PS = (E/TE) X 100]. After the raw data were transformed into percentage scores, the range of expressions was collapsed from the initial 9-point Likert scale into 3- and 5-point scales. The three category scale was POSitive, NEUtral, or NEGative. The five category scale was Very POSitive (VPOS), Slightly positive (SPOS), NEUtral, Slightly negative (SNEG), and Very NEGative (VNEG).

Amount eaten, to the nearest tenth of a gram, was measured as the difference between the weight of the food sample from pretest to posttest. Since each food was presented in one-half cup quantities, approximately four ounces dry weight, variation in the density of the foods yielded differences in the weight of the food in grams. For example, one-half cup of Jello (@113 g) weighed more than one-half cup dry weight of white potatoes (@.70 g). Thus, the amount eaten shown for one bite of Jello could reflect a larger number of grams eaten than that in one bite of potato. The difference in gram weight between one bite of Jello and one bite of potato might suggest that more Jello was consumed than potato. Therefore, to accommodate the difference in density of foods, amount eaten was calculated as a percent difference score, that is, the difference between pre- and postweights in gram weight divided by gram weight at pretest.

Interrater reliability on latency, gustofacial response and behavioral measures was assessed on 16 randomly-drawn subjects using the gamma statistic for the correlation of discrete data in ordered categories. Gamma (G) was estimated as the ratio of the difference between concordant (C) and discordant (D) pairs over the total number of paired comparisons [G = (C-D)/(C+D)]. Gamma was applied independently to 36 measures over 16 paired comparisons. Raters agreed on 89% of the measures.

The General Linear Model (GLM) analysis of variance was employed in all a priori analyses of variance because of unequal cell sizes (Table 1-E, Appendix E). Only reliable effects are reported.

Latency data in seconds, Percentage Gustofacial Response data, frequency of Behavioral Indices and Amount Eaten in grams, were analyzed with a 2 (AGE) X 2 (FOOD) X 2 (PRESenter) between-subjects GLM. To evaluate the third hypothesis, latencies to the second bite were compared for combinations of conditions of novel (N) and familiar (F) food and presenter cues (i.e. NN, NF, FN, & FF) using a 2 (AGE) X 4 (CONDITIONS: NN, NF, FN, & FF) ANOVA. Type I Sums of Squares (SS) are reported in Tables; exceptions where Type III SS are reported are noted. Duncan's Multiple Range

Test and Bonferroni (Dunn) T Tests were employed to evaluate simple effects. Duncan's test controls for the comparisonwise error rate, whereas the Bonferroni test controls for the experimentwise error rate. The Bonferroni test generally has a higher Type II error rate.

Percentage Gustofacial Response data were analyzed in a mixed design with between-group factors as cited above and a within-subjects factor which reflected three (POS, NEU, NEG) or five (VPOS, SPOS, NEU, SNEG, VNEG) dimensions of expression. Results of analyses with the 5-point expression scale generally mirrored conclusions of analyses with the 3-point scale and are reported only when 5-point scale findings clarifed the results of 3-point scale.

Fisher's Independent-Samples Test for homogeneity of variances was applied to all the raw data sets to validate the assumptions of the parametric tests (Table 2-E). Stem leaf and boxplots for each data set were visually inspected (Olson, 1985, pp.59-60) and univariate analysis of the distribution were performed to determine positive skewness or non-zero kurtosis (Table 2-E). To correct the distribution toward a normal curve, a base ten logarithmic transformation was applied to latency data and a square root transformation, to behavioral data (Olson, 1985, pp. 660-661). Data transformation reduced skewness more closely to the symmetric model and brought kurtosis closer to zero only in some cases. Fisher's F-Max Test was applied to transformed data sets (Table 2-E). Finally, failure of logarithmic or square root transformation to correct homogeneity in latencies and behavioral indices, respectively, justified a comparison of results of analyses of variances with those of nonparametric analyses.

All statistical results of parametric tests on the raw data are located in Appendix E. Chi-Square Approximations from the Kruskal-Wallis Test are only reported in the text when nonparametric tests found reliable effects which were not revealed through parametric tests. Analyses of variance of the transformed data consistently mirrored conclusions of the raw data sets and will not be reported.

In the section on Convergent Measures frequencies of gustofacial responses, behavioral indices and percentage intake scores were evaluated as evidence of aversiveness which could explain evidence of neophobia in latency data. Analyses include Pearson Product Moment Correlations between these variables and latencies to the first two bites. Coefficients and ANOVAs are only reported for dependent variables reliably related to latency measures.

All figures are located in Appendix F. Raw data are located in Appendix G.

RESULTS

Latency Data

First Bite

Figure 1 presents mean latencies to the first bite for age groups which received a familiar (FAM) or a novel (NOV) food from a familiar or novel presenter (PRES). Latencies to the first bite were longer in the novel presenter condition for both age groups. ANOVA of the data in Figure 1 (Table 3-E) yielded reliable effects for presenter and no reliable effects for age or food. Analysis of the latency data for the first bite confirmed the first hypothesis that latency to initiate eating would be longer in the novel presenter condition.

Second Bite

Figure 2 presents mean latencies to the second bite for age groups which received a familiar or novel food from a familiar or novel presenter. Toddlers showed longer latencies to the second bite than did infants. Both age groups showed longer latencies to the novel than to the familiar presenter. ANOVA of the data in Figure 2 (Table 4-E) yielded reliable main effects for age and presenter, but no reliable effects for food. Nonparametric tests showed reliable differences between presenter conditions by age group and food condition (X = 14.91 (7 df, N = 64), $p <$

.05). Simple effects tests found longer latencies to the novel than to the familiar presenter among infants who received a novel food.

In the prior analyses, the second hypothesis was tested with analysis of latencies to the second bite per se. Hypothesis 2 was further evaluated with a repeated measures ANOVA to determine whether novelty produced differences in latencies from first bite to second bite. ANOVA of the data in Figures 1 and 2 revealed a reliable effect for presenter and a Bite X Age interaction (Table 5-E). Simple effects ANOVA showed that toddlers had reliably longer latencies on the second bite than did infants but no age-related differences occurred on the first bite.

The second hypothesis stated that latencies to the second bite would be longer in the novel than in the familiar food condition. That hypothesis was not confirmed.

The third hypothesis predicted that, prior to the second bite, latencies to the combination of novel presenter and novel food cues (NN) would be reliably larger than latencies to conditions which provided mixed cues, novel presenter-familiar food (NF) or familiar presenter-novel food (FN). The mean latencies by condition (e.g., NN, NF, FN, FF), arranged from longest to shortest, were: NN, NF, FN, FF for infants, and NF, NN, FF, FN for toddlers. A two-way ANOVA of the data in Figure 2, with age and conditions as factors, showed reliable effects for age (Table 6-E). Effects for condition approached statistical significance ($F(3,56) = 2.42$, $p = .07$). Duncan Tests for the means by presenter/food condition in Figure 2 found significant differences between latencies in the NN and FN (familiar presenter/novel food) comparison. Thus, the third hypothesis was not confirmed although there was a trend in the data toward longer latencies to combinations of novel cues than to mixed cues of novel food from a familiar presenter.

Gustofacial Data

Categories for the gustofacial responses were simplified for analysis from the 9-point Likert scale to a 3-point scale with Positive, Neutral and Negative categories, and to a 5-point scale with Very Positive, Slightly Positive, Neutral, Slightly Negative and Very Negative categories. The fourth hypothesis predicted that toddlers would show more negative gustofacial responses to novel foods than would infants. This hypothesis was tested with percentage frequencies of gustofacial expressions observed after the first bite of food.

Figures 3 and 4 show the mean percentage time prior to the second bite that Negative expressions occurred in age groups which received familiar or novel food. Figure 3 shows data for the 3-point scale; Figure 4 shows data for the 5-point scale. In both figures, more Negative expressions were observed in toddlers than in infants. For toddlers more Negative expressions were observed in the novel than in the familiar food condition. The 5-point scale shows that the Negative expressions were most frequently Slightly Negative in intensity. However, ANOVAs (Tables 7- & 8-E) of the data in Figures 3 and 4 found no reliable effects for age or food conditions ($p > .05$).

To evaluate whether the incidence of negative expressions changed from before the first bite to after the first bite, repeated measures ANOVA were performed on percentage of time that negative expressions were observed before (Figures 5 and 6) and after (Figures 3 and 4) the first bite of food. Figures 3 and 5 show data for the 3-point scale; Figures 4 and 6 show data for the 5-point scale. Negative expressions were most frequently Slightly Negative in intensity, but some Very Negative expressions were observed in infants in the familiar food Condition. No reliable effects were found for age, food, bite (Tables 9-, 10- and 11-E), or presenter (Table 12-E) in parametric tests. Thus, there were no significant increases in the incidence of negative expressions from before to after the first bite. The fourth hypothesis proposed that greater frequencies of negative expressions would occur prior to the second bite in toddlers than in infants. That hypothesis was not confirmed.

Measures of Aversiveness

In the present view of food acceptance, the postponement of ingestion or food refusal may occur due to the novelty of the ingestible or the novelty of the presenter. Novelty is presumed to have aversive properties. Aversiveness may be indicated in other measures which accompany the delay of ingestion. For example, indices of aversiveness may be the percentage frequencies of negative gustofacial expressions, behavioral indices of food refusal, and percentage intake scores. The relationships between these indices of aversiveness and latency data were evaluated to test for evidence of convergence. Measures that were reliably correlated to the latency data were further evaluated for evidence that the effects of the variables, novel food or presenter cues, were similar to those found in latency data.

First Bite Latencies

Table 13-E shows the correlation coefficients between behavioral indices and latencies to the first bite for each age group. Positive (3-point scale) and Slightly Positive (5-point scale) Expressions showed a reliable positive correlation to latencies for both age groups (Table 13-E). The greater the percentage frequencies of positive expressions, the longer the latencies to the first bite.

Neutral Expressions showed a reliable negative correlation to latencies for both age groups (Table 13-E). The lower the percentage frequencies of neutral expressions, the longer the latencies to the first bite. Analyses of frequencies of gustofacial expression were examined for similar effects of the independent variables that were evident in the latency data. Investigation of the effects of presenter and food variables on frequencies of positive and neutral expressions, such as those found in latency data, continued, but not as an index of aversion.

Figures 7, 8, 9, and 10 show the mean percentage time that each gustofacial expression was observed prior to the first bite for each age group on 3- and 5-point Expression scales, respectively. No Negative expressions were observed in infants to the novel presenter in the novel food condition. The Neutral expression occurred most frequently. Infants (Figures 7 & 8) showed Positive expressions more frequently in the novel than in the familiar food condition, and Positive expressions more frequently in the novel than in the familiar presenter condition. Toddlers (Figures 9 & 10) showed Positive and Negative expressions more frequently in the familiar than in the novel food condition. The 5-point scale indicated that the Positive and Negative expressions were most frequently Slightly Positive and Slightly Negative expressions. Some Very Positive and Very

Negative expressions were observed in infants who received a familiar food from a novel presenter (Figure 8) but no Very Positive or Very Negative expressions were observed in toddlers (Figure 10) in any condition prior to the first bite. ANOVA of the 3-point scale data of Figures 7 and 9 found reliable effects for Expression (Table 14-E), but not for age or presenter. Duncan's Test found reliable differences among Neutral, Positive and Negative expressions ($p < .05$). Bonferroni Test found reliable differences between the Neutral expression and Positive and Negative expressions ($p < .05$), which did not differ reliably from each other ($p > .05$).

ANOVA of the 5-point scale data of Figures 8 and 10 found a reliable effect for Expression and an interaction for Age X Food/PRESenter condition (Table 15-E). On the 5-point scale, Bonferroni Tests showed that Neutral expressions occurred with the greatest frequency. Slightly Positive and Slightly Negative expressions occurred at about the same frequency, with Slightly Positive expressions occurring more frequently than Very Negative or Very Positive expressions. The interaction occurred because toddlers showed no incidence of Very Positive or Very Negative expressions on the 5-point scale under any food/presenter condition, whereas infants did show Very Positive and Very Negative Expressions but only in the familiar food/novel presenter condition.

Despite reliable results of correlational analyses, no reliable effect for novel presenter was found in ANOVAs on percentage frequencies of gustofacial expression similar to that found in the first bite latency data. Thus, there was no evidence to conclude that the correlation between frequencies of Positive and Neutral gustofacial expressions and latencies to the first bite reflected similar effects of presenter on gustofacial data as shown in the latency data.

Table 13-E shows that two behavioral measures, flexion of the upper extremities and pushing food away were significantly positively correlated to latencies to the first bite for both age groups. The greater the frequencies of upper body flexion and incidents of pushing food away, the longer the latencies to the first bite. Frequencies of flexion and pushing food away were correlated with latencies for toddlers. Frequencies of flexion were reliably positively correlated but frequencies of pushing food away were not reliably correlated with latencies in infants (Table 13-E). Figures 11 and 12 present the frequencies of flexion and pushing away food behaviors for each age group. Both age groups showed greater frequencies of flexion to the novel than to the familiar presenter in the novel food condition. Toddlers showed greater frequencies of pushing food away in the novel than in the familiar food condition.

Infants showed greater frequencies of flexion and pushing food away to the novel than to the familiar presenter in the familiar food condition. Parametric (Tables 16- and 17-E) analyses of the data in Figures 11 and 12 found no reliable effects for age, food or presenter.

Second Bite Latencies

Table 18 shows the correlation coefficients between behavioral indices and latencies to the second bite. Frequencies of two classes of expression on 3- and 5-point scales and frequencies of upper body flexion were reliably correlated with latencies for infants, and frequencies of upper body flexion were reliably correlated with latencies for toddlers. The greater the percentage frequencies of Positive expressions and the lower the percentage frequencies of Neutral expressions were, the longer the latencies. Table 18-E shows that frequencies of Positive, Neutral, and Very POSitive expressions correlated significantly with latencies to the second bite for infants, but not for toddlers. It is surprising to note the lack of a reliable correlation between second bite latencies and gustofacial expressions among toddlers because latencies were reliably longer to the second bite for toddlers than for infants (see Table 4-E).

Figures 13, 14, 15, and 16 show the mean percentage frequencies of gustofacial expressions on 3- and 5-point scales prior to the second bite in each age group. The Neutral expression was most frequently observed in both age groups. ANOVAs of the data in Figures 13-16 found reliable results only for Expression (Tables 19- and 20-E). For the 3-point scale, Duncan and Bonferroni Tests found greater frequencies of Neutral expressions than Positive or Negative expressions ($p < .05$), which did not differ reliably from each other.

Upper body flexion was reliably positively correlated to latencies to the second bite for both age groups (Table 18-E). The greater the frequencies of upper body flexion were, the longer the latencies. Figure 17 shows mean frequencies of upper body flexion for each age group. Frequencies of flexion were greater to the novel than to the familiar presenter in the familiar food condition. Parametric (Table 21-E) analyses of the data in Figure 17 found no reliable effects for age, food or presenter. There was no evidence that the correlation between upper body flexion and latencies to the second bite could be attributed to the effects of novelty of the presenter as was found in latency data analyses.

Percentage Intake Data

In the present study, percentage intake scores reflected the amount eaten relative to amount served to adjust for the different densities of food stimuli presented in one-half cup servings. The larger the percentage intake score was, the greater the amount eaten. Table 22-E shows the correlation coefficients between percentage intake scores and latencies to the first and second bites for each age group. Percentage intake scores were reliably negatively correlated to latencies for each bite. The less the percentage intake scores were, the longer the latencies.

Figure 18 shows the mean percentage intake data for age groups which received a novel food or presenter. Percentage intake scores for infants and toddlers were less in the novel than in the familiar presenter condition. Percentage intake scores were generally less for infants than for toddlers in all conditions except for the familiar food-novel presenter condition. However, parametric (Table 23-E) analyses of the data in Figure 18 found no reliable effects for age, food or presenter. Thus, there was no reliable evidence to suggest that percentage intake scores, although they were reliably correlated with latency data, showed the same effects of the novel presenter and food that were found in latency data analyses.

DISCUSSION

This experiment demonstrated neophobia to a novel presenter in infants and toddlers: latencies to the first bite were longer to the novel than to the familiar presenter in both age groups. These data partially supported the two-stage model of ingestion. Presumably, the cues from the presenter (e.g., visual, auditory and olfactory) provided distal information which elicited approach toward the food cue. According to the model, if distal cues were novel, as in an unfamiliar presenter, latency of approach would be slower than if distal cues were familiar- and that's what happened.

However, data for the second bite did not support the model. There were no reliable effects due to novel food cues. Thus, the role of proximal food cues on the continuation of ingestion to the second bite was not supported. Neophobia to combinations of novel presenter and novel food cues was observed in infants, but not in toddlers, prior to the second bite, suggesting developmental differences in neophobia. Finally, toddlers did not show greater percentage frequencies of aversive gustofacial expressions on the second bite as did younger infants.

Evidence of neophobia to the novel presenter reflected the influence of distal sources of information on latencies to ingest. There were two sources of distal information in this situation prior to the first bite: the novel stimulus complex from the novel presenter and the novel visual appearance of the novel food. Analyses showed that neophobia occurred to the novel presenter but not to the novel food cue prior to the first bite. Novel cues in the presenter may have influenced approach behavior more than did novel visual cues in the food stimulus. These data were consistent with Duncker's (1938) note that subjects attended to presenter cues in the context before they attended to food cues.

The novel characteristic of the presenter was sufficient to cause delay in the onset of eating despite the possible role of stimulus characteristics which might have elicited approach and initiation of ingestion. That is, the novel presenters were well-dressed and engaged in friendly conversation with the experimenter and day-care staff in the presence of the child prior to the onset of food presentation. All presenters were instructed to smile and to treat the subject gently. They were cautioned not to frown, show an indifferent expression, coax or cajole the subject into eating. Neophobia to the novel presenter occurred despite the ambient friendliness of the presenter. The finding of neophobia to a novel presenter in this study was consistent with previous research with toddlers 14- to

20-months-of-age which used a friendly adult stranger (e.g., Harper & Sanders, 1975).

Infants and toddlers showed no reliable evidence of neophobia to novel food cues, as measured by latencies to the second bite. These data were inconsistent with previous research (Beauchamp & Cowart, 1985; Harper & Sanders, 1975). Beauchamp and Cowart (1985) found evidence that suggested neophobia to a novel sweetened solution that had been previously experienced in its unsweetened form as demonstrated by reduced intake of the sweetened solution in six-month-old infants. Harper and Sanders (1975) found neophobia to novel food cues in toddlers 14- to 20-months-of-age.

Findings for food neophobia in infants were not replicated in the present study perhaps because this study used more complex food stimuli than those of prior studies. That is, Beauchamp and Cowart (1985) used a stimulus solution which provided a novel taste cue only, sucrose; the present study provided novel food cues that included visual, olfactory, textural, thermal and taste characteristics. Previous data has indicated that infants develop a preference for complexity at about age one (Kagan, 1971). If the complex of food stimuli in this study are perceived as a complex cue, it may have presented an attractant which counteracted the putative aversive characteristic of novelty. Thus, the effect of novelty may have been attenuated.

Failure to find neophobia to a novel food in latency to the second bite could also have been a function of the types of foods selected for this study or the subjects' prior food history. Foods were selected to minimize the novelty of visual cues, reduce the likelihood of allergic reactions, and avoid confounding neophobia with food rejection based on a particularly aversive taste, such as that in spinach or asparagus. Foods were selected to provide novel taste and olfactory cues but familiar visual cues. For example, from the experimenter's view, orange butternut squash had similar color and textural characteristics to sweet potatoes; red Jello made with water looked like red Jello made with apricot nectar. Most of the food stimuli were from the yellow vegetable category. To assess the likelihood of allergic reactions, the list of potential food stimuli was presented to a pediatric allergy specialist for review and approval. All of the foods were evaluated as low in potential for allergic reaction. Whenever possible, the food that was novel to one subject was the familiar food to another subject so that food rejection could not be attributed to the aversiveness of the taste characteristics of the novel food <u>per se</u>. Consequently, in the present study, the novel foods may not have been sufficiently distinctive from the familiar foods in taste or visual characteristics. This failure may have militated against differences in the effects of novelty and familiarity on latencies to the second bite. Other studies that have used more discrepant flavor or visual cues have found evidence of stimulus discrimination and of neophobia. For example, Reardon and Bushnell (1988) demonstrated discrimination learning in six-month-old infants by serving applesauce made tart with grapefruit juice in colored cups. Harper and Sanders (1975) demonstrated neophobia in 14-month-old toddlers to blue tortilla chips. Since neophobia to novel foods in toddlers has been demonstrated in previous research, the lack of evidence of neophobia in this study may be attributable to the selection of food stimuli.

Studies of neophobia to combinations of novel visual and taste cues (e.g., Beauchamp & Moran, 1984; Lett, 1984, 1980; Wilcoxin, Dragoin, Kral, 1971) have found greater neophobia when both cues are novel than when only one is novel. Based on these findings, the present study predicted greater neophobia to novel food cues in the novel than in the familiar presenter condition (i.e., NN > NF, FN > FF). In contrast, studies by Lubow, Rifkin, and Alek (1976), Mitchell, Kirschbaum, and Perry (1975), Mitchell, Winter, and Moffitt (1980), and Sheldon (1969) have found that neophobia to one novel stimulus is affected by the novelty of other stimuli in the context. For example, Lubow, Rifkin, and Alek (1976) found that learning was greater when a novel stimulus occurred in a familiar context (NF), or a familiar cue occurred in a novel context (FN), than when both stimulus and context were familiar (FF) or novel (NN). The novelty contrast view predicted less neophobia to novel food cues in the novel presenter condition than in the familiar presenter condition. Data from the present study were partially consistent with results of Beauchamp and Moran (1984). Parametric tests of neophobia to combinations of novel cues versus those of mixed familiar/novel cues approached statistical significance (e.g., NN > FN familiar presenter/novel food). Nonparametric analyses of latencies to the second bite showed that combinations of novel presenter and novel food cues evoked neophobia in infants whereas familiar presenter/novel food cues did not. However, results are only suggestive. Other tests of Lubow et al.'s (1976) theory have failed to find reliable differences between stimulus and contextual factors (e.g., Kurz and Levitsky, 1982). Kurz and Levitsky (1982) used a taste-aversion learning paradigm to evaluate Lubow et al.'s (1976) theory. Rats were preexposed to a meshed wire or solid metal cage and to vanilla or anise solutions. Groups received lithium injections under conditions of novel or familiar stimuli or environments corresponding to Lubow et al.'s procedures (i.e., NN, NF, FN, FF). Reliably greater conditioning effects occurred to novel stimuli (NF, NN > FF, FN) and to familiar environments (FF, NF > FN, NN), but Lubow's hypothesized contrast effects were not confirmed (Kurz & Levitsky, 1982).

The fact that neophobia occurred to the novel presenter in the novel food condition for infants, but not for toddlers, prior to the second bite may suggest evidence for developmental differences in neophobia. Previous research has shown developmental differences in neophobia in rats (Baker, Baker & Kesner, 1977, Experiment 4; Misanin, Blatt, & Hinderliter, 1985), in primates (Itani, 1958) and in two- to five-year-old children (Birch et al., 1987). Developmental differences in neophobia prior to 14-months were suggested in the present study by reliably longer latencies to the novel than to the familiar presenter in the novel food condition, according to nonparametric analyses, in infants 6- to 12-months old, but not in toddlers 13- to 24-months old. Failure to find comparable effects in toddlers and infants raises four possible explanations: changes in 1) thresholds of elicitation (Baker & Brandon, 1990), 2) stimulus selection of visual and taste cues (Spear & Kucharski, 1984; Spear & Molina, 1987), 3) cue utilization (Vogt & Rudy, 1984), or 4) lack of sufficient discrepancy between familiar and novel food cues.

Motor, gustofacial and consummatory response systems may show different levels of elicitation over ontogeny (Baker & Brandon, 1990). These differences may occur due to neurological structural or functional changes in development. Structurally, developmental changes in decay gradients and refractory periods in homeostasis may account for prolonged activation or dissociation of construct measures over time intervals. Functionally, developmental changes in automatized responses may account for differences in elicitation thresholds. That is, automatized responses might be under less control, consciously, than some behavioral avoidance measures, which could be influenced by conscious mediation. Further, responses may differ across situations, across subjects or over ontogeny as a function of individual differences and individual experiences.

Age-related differences may occur as a function of stimulus selection. Ontogenetic changes in stimulus selection refer to changes in the determination of which events in a conditioning episode are learned in terms of sensory modality (Spear & Kucharski, 1984; Spear & Molina, 1987). Tests of developmental changes in the roles of visual and taste cues in the control of drinking have shown age differences in stimulus selection in chicks (Franchina, Johnson, & Leynes, 1993, Experiments 2 & 3), but not in two- to five-year-old children (e.g., Birch, McPhee, Shoba, Pirok, & Steinberg, 1987). Franchina et al. found that, after the start of ingestion, older birds responded more readily to taste cues from water and vinegar (Experiment 2) and drank red-colored solutions more rapidly than did younger birds (Experiment 3), although all birds showed neophobia to red. Birch et al. (1987) reported no age-related differences in preexposure effects of novel visual cues or to combinations of novel visual and taste cues in two- to five-year-old children. Data from the present study may indicate age-related differences in stimulus selection between the complex of presenter cues and food cues. For example, nonparametric analyses of latency to the second bite showed neophobia in infants to the novel presenter when food cues were also novel but not in toddlers. In parametric analyses, repeated measures ANOVA showed longer latencies to the second bite for toddlers than for infants. The lack of an interaction between age and novel cues in ANOVA may suggest that toddlers are attending to all stimuli in a different way than are infants.

Spear and Molina (1987) proposed that infant organisms may encode an episode differently than do adults. Patterns of food acceptance may reflect differences in the way in which infants and toddlers process multi-element stimuli, the way their sensory modalities differentiate single-element stimuli, or the way in which their memories operate

(Spear & Molina, 1987). The inherent constraint of immature nervous systems is that young organisms may have a different learning capability than do adult organisms. As sensory and central nervous systems develop, learning capacity changes (Kail & Hagen, 1977; Rudy, Vogt, & Hyson, 1984; Spear & Campbell, 1979). For example, preweanling rats transfer a classically conditioned response across sensory modalities whereas adult rats do not (Spear & Molina, 1987). Developmental differences in use of sensory modalities to select which event in a conditioning episode will be remembered, may occur because sensory modalities themselves may not be well differentiated early in ontogeny (Spear & Molina, 1987). Spear and Kucharski (1984) have proposed that the effects of age on learning may emerge in the older organism's increasing integration of information from the context across time. That is, younger organisms may associate events that occur simultaneously whereas older organisms may associate events that occur in succession. This does not imply increases in the organism's information processing or different associative processes, but suggests increases in the intervals over which organisms may make associations between events. In the present study, differences between infants' and toddlers' responses to combinations of novel visual and novel food cues prior to the second bite, could be explained as developmental differences in associations. Latencies to combinations of novel cues are not reliably different between infants and toddlers (see Figure 2). Note again the comparison of latencies to the familiar presenter/novel food condition in infants and toddlers. Toddlers had longer latencies in the mixed cue condition than did infants. Toddlers did not show a reliable difference between latencies to the novel versus the familiar presenter in the novel food condition. Longer latencies to the familiar presenter/novel food condition in toddlers than in infants suggested that toddlers were responding to the novel food cues, whereas infants were not. Infants' latencies to novel food cues were not reliably different from those to familiar food cues received from familiar presenters. It may be that infants did not make successive associations between elements of the novel presenter and novel food cues but that toddlers did. Accordingly, the failure for infants to show longer latencies to novel food cues from a familiar presenter would support the two-stage model of ingestion. If distal cues antedated proximal cues, and if infants did not make successive associations, then when infants were presented with mixed cues of familiar distal and novel proximal cues, infants may not have integrated the most recent event, the novel food cue, and latencies reflect response to the familiar presenter cue. Infants may have responded to the mixed cues as they would to a familiar food cue from a familiar presenter. Since toddlers did show neophobia to mixed cues, they apparently responded to the cues successively.

Neophobia presumably reflects the aversiveness of novelty. Consequently, indices of aversiveness were expected to concur with latency measures of neophobia. Latencies to the first bite were reliably correlated to measures of aversiveness, such as flexion of the upper extremities and pushing the food away. The role of novelty in distal cues was underscored by the subjects' pushing the food away before they had tasted it.

Negative gustofacial expressions purportedly reflect displeasurable hedonic consequences of ingestion (e.g., Chiva, 1982; Pfaffman, Norgren, & Grill, 1977; Steiner, 1973, 1977, 1979a, 1979b). Greater frequencies of negative expressions were expected after the first bite of food in novel food conditions. However, the most frequently appearing expression in all experimental conditions was neutral. Greater percentage frequencies of negative gustofacial expressions to novel tastes were not found in toddlers. These data were inconsistent with Chiva's findings (1982). There was a trend toward greater percentage of occurrence of negative expressions in toddlers than in infants, and more negative expressions in toddlers in the novel than in the familiar food condition. However, these data were not reliable and did not support the fourth hypothesis.

Failure to find reliably greater percentages of negative gustofacial expressions could be a function of the rating technique, the raters or the rating scale.
The frequency measure of gustofacial expression may not have been sensitive enough to detect negative expressions. The interpretation of a neutral expression may be a key factor in the failure to find negative expressions. A neutral expression could connote no clearly positive or negative indication from the rater, or could connote indifference by the subject. A neutral expression might have been a negative signal if it had been compared to expressions of the subject under nonexperimental feeding conditions.

Use of a rating technique requires a certain amount of interpretation by the rater. Raters in this study were trained undergraduate research assistants who were unfamiliar with the individual subjects. High interrater reliability rate for gustofacial expressions, 96 percent, did not suggest excessive variability in the rating scale or in the raters themselves. Nevertheless, a neutral expression might have been classified as a negative expression if it had been interpreted by a rater who was familiar with the child's typical range of expression.

Consequently, expressions that were categorized as neutral might have been expressions of the subject's caution or hesitation towards the food, which were undetected as negative indices by the raters.

Facial expressions were rated on a 9-point Likert scale with five as neutral between positive and negative poles. Raters counted the frequency of each expression and recorded the percentage with which each expression was observed during each timed interval. Use of videorecordings in this study allowed repeated analyses of observations and greatly extended the discrimination capabilities of the raters (e.g., Cairns & Green, 1979). Latencies require limited interpretation by the recorder whereas gustofacial expressions and behavioral indices are inherently subjective despite attempts to reduce subjectivity by thoroughly training the raters and explicit operational definitions. The 9-point Likert scale was selected to reduce ambiguity and to afford a measure of intensity through a broad range of expressions. The ratings in this study also reflected high interrater reliability. Nevertheless, equal line segments along our expression continuum did not assure qualitatively equal scaling between the categories of expressions. Latency may be a more sensitive measure of neophobia than is gustofacial expression or behavioral indices. Latency measures ensure greater objectivity through uniform interval scales whereas gustofacial scales are based on nominal and ordinal scales. Thus, grossness of measures or differences in sensitivity of scales may account for the desynchrony of construct-related measures in this study.

The data from the present study failed to find evidence for the role of proximal cues in the continuation of eating. According to the two-stage model, longer latencies to the second bite were expected for novel than for familiar food cues in the second phase of ingestion. In the absence of distinctive taste cues in the novel food condition, the experiment may not have provided sufficiently novel proximal cues to demonstrate the separation of the roles of distal and proximal sources of information. Another plausible explanation may be that ingestion does occur in two phases, as proposed, but the phases are not as discretely separated as suggested in the model. The effects of distal cues may continue to influence ingestion after the first bite. In a study of the two-stage model of ingestion, Franchina, Johnson, and Leynes (1992, Experiment 3) measured the effects of intensity of visual cues- 0% to 1.0% of red food-coloring in water- on latencies to start and to continue drinking ingesta in chicks three-, five-, and seven-days old. They reported that novel visual cues continued to influence drinking a familiar solution, water, in chicks after the first drink. Latencies to complete ten bill dips were slower and intakes were less, the higher the concentration of red food-coloring added to tap water. Despite the familiar taste of tap water, novel visual cues continued to influence consummatory responses. According to the two-stage model, experience with a familiar taste after the start of ingestion should have overcome the influence of novel visual cues and facilitated intake (Lett, 1980). In contrast, data of Franchina et al. suggested that the novelty or intensity of the red visual cues may have evoked avoidance tendencies which counteracted the influence of familiar taste cues to facilitate consumption: the greater the novelty of visual cues, the slower the latencies to drink. In the present experiment, the novelty of the presenter may have evoked similar avoidance tendencies which counteracted the influence of taste cues to elicit consummatory behavior in the familiar food condition.

If novelty has aversive properties then behavioral measures of aversiveness should correlate with latency measures of neophobia and should show similar effects of presenter and food variables in ANOVA. Behavioral indices of aversiveness did correlate reliably with latency measures. However, the effects of the novel presenter and novel food cues on behavioral measures differed from their effects on the latency data. This inconsistency of results suggested that the correlations between latencies and behavioral indices could not be explained by the aversiveness of novelty. Possibly, the lack of convergence in analyses could have been a function of differences in sensitivity of the measures, the grossness of the scales for behavioral measures, or desynchrony in the threshold of activation for effects of novel cues in different response systems.

Different dependent measures of a common construct may be interrelated but may show response desynchrony because response systems are discordant (Baker & Brandon, 1990). Response systems may be discordant either because different construct-related systems have different levels of elicitation, different responses may show different levels of elicitation within a system over ontogeny, or because different construct-related responses may develop across situations or across subjects (Baker & Brandon, 1990). Dependent measures that are sensitive to one response set may be discordant with another response set at low levels of stimulation (e.g., Rachman & Hodgson, 1974). For example, behavioral avoidance responses, such as fleeing, may have higher activation thresholds than do other fear responses such as discomfort, vigilance and scanning. Different psychophysiological or behavioral correlates of fear may result across different contexts or different individuals (e.g., Lang & Lazovik, 1963) as a function of different experiences. For example, memories of affective responses, such as fear, may be contextually bound with responses, such as motor programs for fear responses (e.g., Lang, Levin, Miller, & Kozak, 1983). Nevertheless, manifestations of a construct may have utility even though construct-relevant responses may be desynchronous across construct measures, ontogeny, situations or subjects. Changes in thresholds of elicitation of responses may account for failure for these food stimuli to produce neophobia in the present study.

The fourth hypothesis predicted greater percentage frequencies of negative gustofacial expressions in toddlers after the first taste of a novel food. This hypothesis was not supported: Neutral expressions showed the highest percentage frequency across all conditions. However, the data did show other evidence of developmental differences in expressions to neophobia. Although percentage frequencies of negative gustofacial expressions did not correlate reliably with latency data, percentage frequencies of positive gustofacial expressions were reliably positively correlated with second bite latency data in infants only. Latencies for toddlers to the second bite did not show reliable correlations with percentage frequency of positive gustofacial expressions but did correlate reliably with flexion aversiveness data.

The reliable correlation between second bite latencies and positive expressions could suggest attraction to novelty in infants. Analyses of the data to measure effects of presenter and food on percentage frequencies of gustofacial expressions, however, were not significant. Reliable correlations between latency data for infants and flexion measures of aversiveness cast further doubt on an explanation of latencies based on attraction of novelty.

FUTURE RESEARCH

The failure to find neophobia to a novel food in this experiment could be attributed to a lack of distinctive visual or taste cues in the food. In future experiments, it might be advisable to employ more distinctively novel stimuli. If novelty occurs along a continuum (e.g., Piaget, 1952), and neophobia is a function of stimulus concentration (e.g., Miller & Holzman, 1981a) then the manifestation of neophobia should be proportional to the degree of novelty dependent on the intensity of visual cues or on taste concentration. Reliable and direct effects of intensity of visual cues, and of taste concentration, on consummatory response latencies have been demonstrated in three-, five-, and seven-day-old chicks, and in seven-day-old chicks, respectively (Franchina et al., 1993). Future studies should perform titration studies of novel visual cue intensity and novel taste concentration on infants of two ages. Novel cues from distal sources should be minimized by using only a familiar food presenter. For studies of the effects of novel visual cues in foods, other food-related cues should be held constant. For example, the food stimulus could be like Jello made from Knox gelatin powder. Taste, textural, thermal, and olfactory cues would be held constant but intensity of red food coloring would be produce varied visual cues. For studies of the effects of novel taste cues in foods, novel visual, thermal, textural and olfactory food-related cues could be reduced by adding different levels of taste concentrate to the same source food. For example, the food stimulus could be red Jello made with incremental ratios of apricot nectar and water or grapefruit juice and water. Measures of performance would be latencies to the first ten bites, frequencies of gustofacial expression, behavioral indices of food rejection, and intake. This type of study would be useful to investigate neophobia to visual and taste cues and to separate neophobia to novel visual and novel taste cues from neophobia to other food-related cues, such as temperature, olfactory, and textural cues, in infants of two ages. Future studies could explore the role of novelty in the other food-related cues as well and examine the effects of combinations of novel food-related cues. After a food stimulus has been identified as novel, the present experiment could be replicated. The results may have theoretical implications about the roles of visual and taste cues on consummatory behavior in infants, neophobia to novel food cues and to combinations of food cues. Hypotheses concerning developmental differences in neophobia and the utility of the two-stage model could be reconsidered with revised food stimuli in replication.

In the present study, longer latencies in the novel than in the familiar presenter condition confirmed neophobia to novel presenter cues. Future studies could further investigate specific aspects in the stimulus complex of the presenter. Specifically, they could examine the role of the presenter's facial expression on the subject's affect and subsequent approach and ingestion of food. Research has shown that complex cues in the food, in the social context or from the physiological consequences of eating may influence affect (e.g., Birch, 1990a). Further, the affect generated in the social context of eating can positively or negatively influence children's preference (Birch 1990a, 1990b; Casey & Rozin, 1989). Effects of variations in the presenter's facial expression in the context of eating could be compared to the effects of novelty in the food cue. This design could vary the facial expressions, positive, negative or neutral, which a familiar caretaker produces under novel or familiar food cue conditions. Research on the facilitative role of the familiar caretaker on food acceptance would predict that presenter cues would override the novelty/familiarity dimension of the food cue (e.g., Galef, 1977; Galef & Clark, 1971a, 1971b; Hogan, 1966; Rozin, 1990b). Galef's research would predict that negative affective expressions in the familiar caretaker should lead to longer latencies to approach either a familiar or novel food. Findings from the present study predict that longer latencies should occur to foods served by a novel presenter even if the presenter produces a positive affective expression. This research could also investigate developmental differences in the use of social referencing in the context of food acceptance. Social referencing is the tendency for children in ambiguous situations to deliberately seek affective information from caregivers and use it to determine approach/avoidance behaviors (e.g., Campos & Steinberg, 1981). The emergence of social referencing during the second half of the first postnatal year may determine ontogenetic effects in social referencing with strangers (e.g., Klinnert, Emde, Butterfield, & Campos, 1986) or with familiar presenters in the context of food acceptance (e.g., Harper & Sanders, 1975).

The behavioral measures in this study were obtained from ratings of videotaped sessions by trained undergraduate research assistants. Outcomes of behavioral ratings might differ according to the rater's experience with the subject. Adults who are familiar with the subject's typical behavior in the context of eating and range of expressions might classify expressions differently than did raters who were not familiar with the subject. These videotaped sessions could be rated by the subjects' parents and the familiar caretakers at the day care centers. Comparisons of ratings would yield important theoretical and methodological information about interpretation of gustofacial expressions and other indices of aversiveness. Theoretically, re-classifications of neutral expressions might reveal developmental differences in gustofacial responses as predicted in the fourth hypothesis. Methodologically, analyses of interrater reliability across groups- trained undergraduate assistants, parents and day-care staff- may qualify the generalizability of these or future findings.

In the present study, the emphasis in experimental design was on the manipulation of novelty in the environment. Future studies should explore the relative contributions organismic factors in ingestional neophobia. Berlyne (1960, 1968, 1969; Barnett, 1963, 1975) proposed that the organism's response to novelty represented an interaction between the organism's initial state of arousal and the arousal value of the stimulus. Prenatal experiences and the organization of the newborn nervous system may contribute to organismic factors in temperamental dispositions of approach and avoidance (e.g., Thomas & Chess,1977). Schneirla (1959, 1965) would predict that low intensities of stimulation evoke approach responses and that high intensities evoke avoidance responses. Information about high versus low intensity in stimuli, therefore, becomes mutually determined by the quality of the stimulus in the environment and the prior history of the organism. Chiva (1979) has posited that stable and persistent individual differences in infants' facial responses to taste stimuli played a role in determining preference. For example, Chiva classified subjects into three categories: hypergeusic, strong responders to taste stimuli, normal-range infants, and hypogeusic, weak responders to taste stimuli (Beauchamp, 1981). Hypergeusic responders were reported to exhibit strong emotional responses in other contexts. Chiva's hypothesized categories of facial responding assume an inherently stable response tendency. The stability of initial infant temperament over ontogeny, however, has been found to be subject to change as a function of the interaction of the child's disposition and its postnatal experience (Kagan, Resnick, & Snidman, 1988; Kagan, Snidman, & Arcus, 1992; Putallaz, 1987; Thomas & Chess, 1977; Zeskind & Ramey, 1978, 1981). Just as enhanced arousal has been shown to increase neophobia (Berlyne, 1960, 1968, 1969), preexposure effects which typically attenuate neophobia may change the affective state in the organism. Longitudinal studies of ingestional neophobia and preexposure effects with infants who are classified into high and low reactivity groups may yield important information about purported differences in temperament and reactivity to novelty (e.g., Chiva, 1979) and evaluate the transactional effects of exposure to variety in novelty on reactivity. The influences of the infant's state of arousal might be separated from the arousal value of the stimulus by including measures of the infant's internal state of arousal in magnitude of heart-rate acceleration, pupillary dilation and diastolic blood pressure (Kagan, 1989; Kagan, Reznick, & Snidman, 1988; Kagan & Snidman, 1991a, 1991b) before and after the presentation of novel and familiar food-related stimuli. For example, Kagan and colleagues have developed a technique to separate infants prior to four months-of-age into high reactive and low reactive groups based on changes in magnitude of heart-rate acceleration, pupillary dilation and diastolic blood pressure when their posture changes from sitting to standing (Kagan, 1989; Kagan, Reznick, & Snidman, 1988; Kagan & Snidman, 1991a, 1991b). Findings suggested that these two groups also differed in sympathetic reactivity (Kagan et al., 1992) and in hemispheric desynchronization of the frontal area related to the mediation of affect (Davidson, 1992; Fox, 1991). Future studies might include comparisons of the infant's reactions to novelty from different classes of stimuli, such as objects or strangers (e.g., Kagan, Snidman, & Arcus, 1992), across contexts, across stimuli, and across time.

Developmental changes in ingestional neophobia have been investigated in human infants (e.g., Beauchamp, 1981;

Beauchamp, Bertino, & Engelman, 1985; Beauchamp & Moran, 1984; Bertino, Beauchamp, & Engelman, 1982; Birch, McPhee, Shoba, Pirok, & Steinberg, 1987; Desor, Maller, & Andrews, 1975; Harper & Sanders, 1975; Vasquez, Pearson, & Beauchamp, 1982) but age-related differences in preexposure effects have not been as vigorously pursued (Birch et al., 1987). Developmental changes in preexposure effects have been documented in other species, such as chickens (Capretta, 1969) and rats (Capretta, Petersik, & Stewart, 1975; Misanin, Guanowsky, & Riccio, 1983; Misanin, Blatt, & Hinderliter, 1985). Future studies should investigate developmental differences in preexposure effects in infants and young children through the use of multiple trials and longitudinal designs. Multiple trials would permit classification of responses of neophobia and food rejection. Longitudinal designs would facilitate measures of age changes in preexposure effects. Ontogenetic changes in preexposure effects may account for changes in neophobia. Further, understanding of developmental differences in preexposure effects may be useful in applied settings for the timing of interventions, reducing nutrition risks due to narrowed choice of diet based on neophobia, and may be fruitful for research in exposing underlying mechanisms in food acceptance.

REFERENCES

Amerine, M.A., Pangborn, R.M., & Roessler, E.B. (1965). Principles of sensory evaluation of food (p. 602). New York: Academic Press.

Atkinson, J., & Braddick, O. (1982). Sensory and perceptual capacities in the neonate. In P. Stratton (Ed.), Psychology of the human newborn. Chichester, England: Wiley.

Baker, L.J., Baker, T.B., & Kesner, R.P. (1977). Taste aversion learning in young and adult rats. Journal of Comparative and Physiological Psychology, 91, 1168-1178.

Baker, T.B., & Brandon, T.H. (1990). Validity of self-reports in basic research. Behavioral Assessment, 12, 33-51.

Bakwin, H., & Bakwin, R.M. (1972). Behavior disorders in children. Philadelphia: Saunders.

Banks, M.S., & Salapatek, P. (1983). Infant visual perception. In P.H. Mussen (Ed.), Handbook of child psychology: Vol. 2. Infancy and developmental psychobiology. New York: Wiley.

Barnett, S.A. (1956). Behaviour components in the feeding of wild and laboratory rats. Behaviour, 9, 24-43.

Barnett, S.A. (1958). Experiments on "neophobia" in wild and laboratory rats. British Journal of Psychology, 49, 195-201.

Barnett, S.A. (1963). The rat: A study in behavior. Chicago: University of Chicago Press.

Barnett, S.A. (1975). The rat: A study in behavior (rev. ed.). Chicago: University of Chicago Press.

Barnett, S.A., & Spencer, M.M. (1953). Experiments on the food preferences of wild rats (Rattus Norvegicus Berkenhout). Journal of Hygiene, 51, 16-34.

Beauchamp, G.K. (1981). Ontogenesis of taste preferences. In D.N. Walcher and N. Kretchmer (Eds.), Food, nutrition and evolution: Food as an environmental factor in the genesis of human variability (pp. 49-57). New York: Masson.

Beauchamp, G.K., Bertino, M., & Engelman, K. (1983). Modification of salt taste. Annals of Internal Medicine, 98, 763-769.

Beauchamp, G.K., Bertino, M., & Engelman, K. (1985). Sensory basis for human salt consumption. In M.J. Horan, M.P. Blaustein, J.B. Dunbar, W. Kachadorian, N.M. Kaplan, and A.P. Simopoulos (Eds.), NIH workshop on nutrition and hypertension (pp. 113-124). New York: Biomedical Information Corporation.

Beauchamp, G.K., & Cowart, B.J. (1985). Congenital and experiential factors in the development of human flavor preferences. Appetite, 6, 357-372.

Beauchamp, G.K., & Moran, M. (1982). Dietary experience and sweet taste preference in human infants. Appetite, 3, 139-152.

Beauchamp, G.K, & Moran, M. (1984). Acceptance of sweet and salty tastes in 2-year-old children. Appetite, 5, 291-305.

Beck, M., Hitchcock, C.L., & Galef, B.G. Jr. (1988). Diet sampling by wild Norway rats offered several unfamiliar foods. Animal Learning and Behavior, 16(2), 224-230.

Benjamin, E. (1942). The period of resistance in early childhood. Its significance for the development of the problem child. American Journal of Diseases of Childhood, 63, 1019-1079.

Berk, L.E. (1991). Child development (2nd Ed.). Boston: Allyn & Bacon.

Berlyne, D.E. (1960). Conflict, arousal, and curiosity. New York: McGraw-Hill.

Berlyne, D.E. (1968). Indifferent exteroceptive stimulation and reinforcement. In D.C. Glass (Ed.) Environmental Influences. New York: Rockefeller Univ. Press.

Berlyne, D.E. (1969). The reward value of light increment under supranormal and subnormal arousal. Canadian Journal of Psychology, 23, 11-23.

Berlyne, D.E., & Slater, J. (1957). Perceptual curiosity, exploratory behavior, and maze learning. Journal of Comparative and Physiological Psychology, 50, 228-232.

Bertino, M. , Beauchamp, G.K., & Engelman, K. (1982). Long-term reduction in dietary sodium alters the taste of sale. American Journal of Clinical Nutrition, 36, 1134-1144.

Best, M.R. (1975). Conditioned and latent inhibition in taste-aversion learning: Clarifying the role of learned safety. Journal of Experimental Psychology: Animal Behavior Processes, 1, 97-113.

Birch, L.L. (1980). Effects of peer models' food choices and eating behaviors on preschoolers' food preferences. Child Development, 51, 489-496.

Birch, L.L. (1987). Children's food preferences: Developmental patterns and environmental influences. In R. Vasta (Ed.), Annals of child development (Vol. 4, pp. 131-170). Greenwich, Ct.:JAI Press.

Birch, L.L. (1990a). Development of food acceptance patterns. Developmental Psychology, 26(4), 515-519.

Birch, L.L. (1990b). The control of food intake by young children: The role of learning. In E.D. Capaldi & T.L. Powley (Eds.), Taste, experience, and feeding (pp. 116-135). Washington, D.C.:American Psychological Asso.

Birch, L.L., & Deysher, M. (1986). Caloric compensation and sensory specific satiety: Evidence for self regulation of food intake by young children. Appetite, 7, 323-331.

Birch, L.L., McPhee, L., Shoba, B.C., Pirok, E., & Steinberg, L. (1987). What kind of exposure reduces children's food neophobia? Appetite, 9, 171-178.

Birch, L.L., & Marlin, D.W. (1982). I don't like it; I've never tried it: Effects of exposure on two-year-old children's food preferences. Appetite, 3, 353-360.

Blass, E.M., & Hall, W.G. (1976). Drinking termination: Interactions among hydrational, orogastric, and behavioral controls in rats. Psychological Review, 83, 356-374.

Blest, A.D. (1957). The function of eyespot patterns in the Lepidoptera. Behaviour, 11, 209-255.

Boice, R. (1976). In the shadow of Darwin. In R.G. Geen and E.C. O'Neal (Eds.), Perspectives on aggression. New York: Academic Press pp. 11-35

Bornstein, M.H. (1984). Perceptual development. In M.H. Bornstein and M.E. Lamb (Eds.), Developmental psychology: An advanced textbook. Hillsdale, N.J.: Erlbaum.

Braun-Bartana, A., Ganchrow, J.R., & Steiner, J.E. (1986). Behavioral reactions to taste stimuli in hatchling chicks. Annals of the New York Academy of Science, 196-198.

Braveman, N.S. (1978). Preexposure to feeding-related stimuli reduces neophobia. Animal Learning and Behavior, 6, 417-422.

Braveman, N.S., & Jarvis, P.S. (1978). Independence of neophobia and taste aversion learning. Animal Learning and Behavior, 6, 406-412.

Brennan, W., Ames, E., & Moore, R. (1966). Age differences in infants' atention to patterns of different complexities. Science, 151, 354-356.

Brett, L.P., Hankins, W.G., & Garcia, J. (1976). Prey-lithium aversions. III. Buteo hawks. Behavioral Biology, 17, 87-98.

Burghardt, G.M., & Hess, E.H. (1966). Food imprinting in the snapping turtle, Chelydra serpentina. Science, 151, 108-109.

Bushnell, I.W.R. (1982). Discrimination of faces by young infants. Journal of Experimental ChildPsychology, 33, 298-308.

Cairns, R.B., & Green, J.A. (1979). How to assess personality and social patterns: Observations orratings? In R.B. Cairns (Ed.), The analysis of social interactions: Methods, issues and illustrations (pp. 209-225). Hillsdale, N.J.: Erlbaum.

Caldwell, G.S., & Rubinoff, R.W. (1983). Avoidance of venomous sea snakes by naive herons and egrets. Auk, 100, 195-198.

Campos, J.J., & Stenberg, C.R. (1981). Perception, appraisal, and emotion: The onset of social referencing. In M.E. Lamb, and L.R. Sherrod (Eds.), Infant social cognition: Empirical and theoretical considerations (pp. 273-314). Hillsdale, N.J.: Erlbaum.

Capretta, P.J. (1961). An experimental modification of food preference in chickens. Journal of Comparative and Physiological Psychology, 54, 238- 242.

Capretta, P.J. (1969). The establishment of food preferences in chicks Gallus. Animal Behavior, 17, 229-231.

Capretta, P.J. (1977). Establishment of food preferences by exposure to ingestive stimuli early in life. In L.M. Barker, M.R. Best, and M. Domjan (Eds.), Learning mechanisms in food selection (pp.99-121). Waco, Tx.: Baylor University Press.

Capretta, P.J., and Bronstein, P.M. (1967). Effects of food ingestion on the later food preferences in chicks. Proceedings of the 75th Annual Convention of the American Psychological Association, 2, 109- 110.

Capretta, P.J., Petersik, J.T., & Stewart, D.J. (1975). Acceptance of novel flavours is increased after early experience of diverse tastes. Nature, 254(April), 689-691.

Capretta, P.J., & Rawls, L.H. (1974). Establishment of a flavor preference in rats: Importance ofnursing and weaning experience. Journal of Comparative and Physiological Psychology, 86, 670- 673.

Casey, R., & Rozin, P. (1989). Changing children's food preference: Parent opinions. Appetite, 12, 171-182.

Caza, P.A., & Spear, N.E. (1984). Short-term exposure to an odor increases its subsequent preference in preweanling rats: A descriptive profile of the phenomenon. Developmental Psychobiology, 17, 407-422.

Chance, R.A., & Mead, A.P. (1955). Competition between feeding and investigation in the rat. Behaviour, 8, 174-182.

Chitty, D. (1954). The control of rats and mice (Vols. 1 & 2). Oxford: Clarendon.

Chitty, D., & Shorten, M. (1946). Techniques for the study of the Norway rat (Rattus norvegicus). Journal of Mammalia, 27, 63-78.

Chiva, M. (1979). Comment la personne se construit en mangeant. Communications, 31, 107-117.

Chiva, M. (1982). Taste, facial expression and mother-infant interaction in early development. Baroda Journal of Nutrition, 9, 99-102.

Cohen, L.B. (1973). A two-process model of infant visual attention. Merrill-Palmer Quarterly, 19, 157-180.

Cole, B.J., Robbins, T.W., & Everitt, B.J. (1988). Lesions of the dorsal noradrenergic bundle simultaneously enhance and reduce responsivity to novelty in a food preference test. Brain Research Review, 13, 325-349.

Coppinger, R.P. (1969). The effect of experience and novelty on avian feeding behavior with reference to the evolution of warning coloration in butterflies. Part I: Reactions of wild-caught blue jays to novel insects. Behaviour, 35(1-2), 45-60.

Coppinger, R.P. (1970). The effect of experience and novelty on avian feeding behavior with reference to the evolution of warning coloration in butterflies. Part II: Reactions of naive birds to novel insects. Behaviour, 104, 323-335.

Cornell, E.H., & McDonnell, P.M. (1986). Infants' acuity at twenty feet. Investigative Opthalmology and Visual Science, 27, 1417-1420.

Cott, H.B. (1940). Adaptive coloration in animals. London: Methuen.

Cross, H.A., & Vaughter, R.M. (1966). The Moss-Harlow effect in preschool children as a function of age. Journal of Experimental Child Psychology, 4, 280-284.

Davidson, R.J. (1992). Emotion and affective style: Hemispheric substrates. Psychological Science, 1, 39-43.

Davis, C. (1928). Self-selection of diet by newly weaned infants. American Journal of Diseases of Children, 36, 651-679.

Davis, C. (1939). Results of self-selection diets by young children. The Canadian Medical Association Journal, 41, 257-261.

Desor, J.A., Maller, O., & Andrews, K. (1975). Ingestive responses of human newborns to salty, sour and bitter stimuli. Journal of Comparative and Physiological Psychology, 89, 966-970.

Domjan, M. (1976). Determinants of the enhancement of flavored-water intake by prior exposure. Journal of Experimental Psychology: Animal Behavior Processes, 2(1), 17-27.

Domjan, M. (1977). Attenuation and enhancement of neophobia for edible substances. In L.M. Barker, M.R. Best, and M. Domjan (Eds.), Learning mechanisms in food selection pp. 151-179. Waco, Texas: Baylor University Press.

Domjan, M., & Bowman, T.G. (1974). Learned safety and the CS-US delay gradient in taste-aversion learning. Learning and Motivation, 5, 409-423.

Domjan, M., & Burkhard, B. (1982). The principles of learning and behavior. Monterey, Ca.: Brooks/Cole Pub. Co.

Duncker, K. (1938). Experimental modification of children's food preferences through social suggestion. Journal of Abnormal Social Psychology, 33, 489-507.

Ernits, T., & Corbit, J.D. (1973). Taste as a dipsogenic stimulus. Journal of Comparative and Physiological Psychology, 83, 27-31.

Eson, M.E., Cometa, M.S., Allen, D.A., & Henel, P.A. (1977). Preference for novelty-familiarity and activity-passivity in a free choice situation. The Journal of Genetic Psychology, 131, 3-11.

Fallon, A.E., & Rozin, P. (1983). The psychological bases of food rejections by humans. Ecology of Food and Nutrition, 13, 15-26.

Fantz, R.L. (1961). The origins of form perception. Scientific American, 204, 66-72.

Fantz, R.L. (1963). Pattern vision in newborn infants. Science, 140, 296-297.

Fantz, R.L. (1964). Visual experience in infants: Decreased attention to familiar patterns relative to novel ones. Science, 146, 668-670.

Feinman, S., & Lewis, M. (1983). Social referencing at 10 months: A second-order effect on infants' responses to strangers. Child Development, 54, 878-887.

Field, T.M., Cohen, D., Garcia, R., & Greenberg, R. (1984). Infant response to facelike patterns underfixed-trial and infant-control procedures. Child Development, 54, 172-177.

Filer, L.J. (1978). Studies of taste preference in infancy and childhood. Pediatric Basics, 12, 5-9.

Fisher, M.A., Sperber, R., & Zeaman, D. (1973). Theory and data on developmental changes in novelty preference. Journal of Experimental Child Psychology, 15, 509-520.

Fomon, S.J. (1974). Infant nutrition (2nd Edition). Philadelphia: W.B. Saunders.

Fox, N.A. (1991). If it's not left, it's right. American Psychologist, 46, 863-872.

Franchina, J.J. (1991). Mere exposure totelereceptive cues facilitates intake of a novel flavor in chickens (Gallus domesticus). Behavioraland Neural Biology, 56, 108-112.

Franchina, J.J., & Dyer, A.B. (1989). Cross-modality transfer effects in conditioning-enhanced neophobia in chicks (Gallus domesticus): Evidence for the separability of novelty from specific stimulus characteristics. Animal Learning and Behavior, 17(2), 261-265.

Franchina, J.J., Johnson, L.J., & Leynes, A. (1993). Roles of visual and taste cues in ingestional neophobia: Response latency in chicks (Gallus domesticus). Manuscript submitted for publication.

Franchina, J.J., & Slank, K.L. (1989). Role of telereceptive and interoceptive (taste) cues in ingestional neophobia in chicks (Gallus domesticus). Behavioral and Neural Biology, 52, 116-122.

Galef, B.G., Jr. (1977). Mechanisms for the social transmission of acquired food preferences from adult to weanling rats. In L.M. Barker, M.R. Best, & M. Domjan (Eds.), Learning mechanisms in food selection (pp. 123-148). Waco, Tx.: Baylor Univ. Press.

Galef, B.G., Jr., & Clark, M.M. (1971a). Parent-offspring interactions determine time and place of first ingestion of solid food by wild rat pups. Psychonomic Science, 25, 15-16.

Galef, B.G., Jr., & Clark, M.M. (1971b). Social factors in the poison avoidance and feeding behavior of wild and domesticated rat pups. Journal of Comparative and Physiological Psychology, 75, 341- 357.

Ganchrow, J.R., Oppenheimer, M., & Steiner, J.E. (1979). Behavioural displays to gustatory stimuli in newborn rabbit pups. Chemical Senses and Flavour, 4(1), 49-61.

Garcia, J., Hankins, W.G., & Rusiniak, K.W. (1974). Behavioral regualtion of the milieu interne in man and rat. Science, 185, 824-831.

Gentile, R.L. (1970). The role of taste preference in the eating behavior of the albino rat. Physiology and Behavior, 5, 311-316.

Goren, C.C., Sarty, J., & Wu, P.Y. (1975). Visual following and pattern discrimination of face-like stimuli by newborn infants. Pediatrics, 56, 544-549.

Grabbe, W., & Campione, J.C. (1969). A novelty interpretation of the Moss-Harlow effect in preschool children. Child Development, 40, 1077-1084.

Green, K.F., & Parker, L.A. (1975). Gustatory memory: Incubation and interference. Behavioral Biology, 13, 359-367.

Greenberg, D.J., Uzgiris, I.C., & Hunt, J. McV. (1970). Attentional reference and experience: III. Visual familiarity and looking time. Journal of Genetic Psychology, 117, 123-135.

Greene, L.S. (1974). Physical growth and development, neurological maturation and behavioral function in two Ecuadorian Andean communities in which goiter is endemic: II PTC taste-sensitivity and neurological maturation. American Journal of Physiological Anthropology, 41, 139-151.

Grill, H.J., & Norgren, R. (1978a). The taste reactivity test. 1. Mimetic responses to gustatory stimuli in neurologically normal rats. Brain Research, 143, 263-279.

Grill, H.J., & Norgren, R. (1978b). The taste reactivity test. II. mimetic responses to gustatory stimuli in chronic thalamic and chronic decerebrate rats. Brain Research, 143, 281-297.

Groves, P.M., & Thompson, R.F. (1970). Habituation: A dual-process theory. Psychological Review, 60, 419-450.

Hankins, W.G., Garcia, J., & Rusiniak, K.W. (1973). Dissociation of odor and taste in baitshyness. Behavioral Biology, 8, 407-419.

Harper, L.V., & Sanders, K.M. (1975). The effect of adults' eating on young children's acceptance of unfamiliar foods. Journal of Experimental Child Psychology, 20, 206-214.

Harris, G., Thomas, A., & Booth, D.A. (1990). Development of salt taste in infancy. Developmental Psychology, 26(4), 534-538.

Haviland, J., & Lelwica, M. (1987). The induced affect response: 10-week-old infants' responses to three emotion expressions. Developmental Psychology, 23, 97-104.

Hogan, J.A. (1965). An experimental study of conflict and fear: An analysis of behavior of young chicks toward a mealworm. Part I. The behavior of chicks which do not eat the mealworm. Behaviour, 25, 45- 97.

Hogan, J.A. (1966). An experimental study of conflict and fear: An analysis of behavior of young chicks toward a mealworm. Part II. The behavior of chicks which do eat the mealworm. Behaviour, 27, 273-289.

Hogan, J.A. (1971). The development of a hunger system in young chicks. Behaviour, 39, 128-201.

Hogan, J.A. (1973). How young chicks learn to recognize food. In R.A. Hinde and J. Stevenson-Hinde (Eds.), Constraints on learning: Limitations and predispositions (pp. 119-139). New York: Academic Press.

Hollinger, M., & Roberts, L.J. (1929). Overcoming food dislikes: A study with evaporated milk. Journal of Home Economics, 21, 923-932.

House, B.J., & Zeaman, D. (1958). Reward and nonreward in the discrimination learning of imbeciles. Journal of Comparative and Physiological Psychology, 51, 614-618.

Itani, J. (1958). On the acquisition and propagation of a new food habit in the natural group of Japanese monkeys at Takasaki Yama. Journal of Primatology, 1, 84-98.

Jusczyk, P.W. (1985). The high amplitude sucking procedure as a methodological tool in speech perception research. In G. Gottlieb and N.A. Krasnegor, (Eds.), Measurement of audition and vision in the first year of postnatal life: A methodological overview (pp. 195-222). Norwood, N.J.: Ablex.

Kagan, J. (1971). Change and continuity in infancy. New York: Wiley.

Kagan, J. (1989). The concept of behavioral inhibition to the unfamiliar. In J.S. Reznick, (Ed.), Perspectives on Behavioral Inhibition. Chicago: Univ. of Chicago Press.

Kagan, J., Reznick, J.S., & Snidman, N. (1988). Bilogical, bases of childhood shyness. Science, 240, 167-173.

Kagan, J., & Snidman, N. (1991a). Infant predictors of inhibited and uninhibited profiles. _Psycholgocical Science_, _2_, 40-44.

Kagan, J., & Snidman, N. (1991b). Temperamental factors in human development. _American Psychologist_, _46_, 856-862.

Kagan, J., Snidman, N., & Arcus, D.M. (1992). Initial reactions to unfamiliarity. _Current Directions in Psychological Science_, _1_(6), 171-174.

Kail, R.V, & Hagan, J.W. (1977). _Perspective on the development of memory and cognition_. Hillsdale,N.J.: Lawrence Erlbaum Asso.

Kalat, J.W. (1977). Status of "learned safety" or "learned noncorrelation" as a mechanism in taste-aversion learning. In L.M. Barker, M.R. Best, and M.J. Domjan (Eds.), _Learning mechanisms in food selection_. Waco, Texas: Baylor Univ. Press.

Kalat, J.W., & Rozin, P. (1970). "Salience": A factor which can override temporal contiguity in taste-aversion learning. _Journal of Comparative and Physiological Psychology_, _71_, 192-197.

Kalat, J.W., & Rozin, P. (1973). "Learned safety" as a mechanism in long-delay taste-aversion learning in rats. _Journal of Comparative and Physiological Psychology_, _83_, 198-207.

Kamin, L.J. (1969). Predictability and surprise, attention and conditioning. In B.A. Campbell & R.M. Church (Eds.), _Punishment and aversive behavior_. New York: Appleton-Century-Crofts.

Kare, M.R., & Beauchamp, G.K. (1985). The role of taste in the infant diet. _The American Journal of Clinical Nutrition_, _41_, 418-422.

Klinnert, M.D., Emde, R.N., Butterfield, P., & Campos, J.J. (1986). Social referencing: The infant's use of emotional signals from a friendly adult with the mother present. _Developmental Psychology_, _22_, 427-432.

Kopp, J., & Bourland, G. (1972, April). _Rats bar press for food in the presence of free food under a variety of free food conditions_. Paper presented at the meeting of the Western Psychological Association, Portland, Oregon.

Kring, A.M., Smith, D.A., & Neale, J.M. (1989). The development of an economical method for coding facial expression. Paper presented at the 97th Annual Convention of the American Psychological Association. New Orleans, La.

Kuo, Z-Y. (1967). The dynamics of behavior development: An epigenetic view (pp. 66-72). New York: Random House.

Kurz, E.M, & Levitsky, D.A. (1982). Novelty of contextual cues in taste aversion learning. Animal Learning and Behavior, 10(2), 229-232.

Kurz, E.M, & Levitsky, D.A. (1983). Lithium chloride and avoidance of novel places. Behavioral Neuroscience, 97(3), 445-451.

Lang, P.J., & Lazovik, A.D. (1963). Experimental desensitization of a phobia. Journal of Abnormal and Social Psychology, 66, 519-525.

Lang, P.J., Levin, D.N., Miller, G.A., & Kozak, M.J. (1983). Fear behavior, fear imagery, and the psychophysiology of emotion: The problem of affective response integration. Journal of Abnormal Psychology, 92, 276-306.

Lerner, R.M. (1987). The concept of plasticity in development. In J.J. Gallagher & C.T. Ramey's (Eds.), The malleability of children. Baltimore: Paul H. Brooks Pub. Co.

Lett, B.T. (1980). Taste potentiates color-sickness associations in pigeons and quail. Animal Learning and Behavior, 8(2), 193-198.

Lett, B.T. (1984). Extinction of taste aversion does not eliminate taste potentiation of odor aversion in rats or color aversion in pigeons. Animal Learning and Behavior, 12, 414-420.

Lipsitt, L.P., & Behl, G. (1990). Taste-mediated differences in the sucking behavior of human newborns. In E.D. Capaldi and T.L. Powley (Eds.), Taste, experience and feeding (pp. 75-93). Washington, D.C.: American Psychological Association.

Lubow, R.E., Rifkin, B., & Alek, M. (1976). The context effect: The relationship between stimulus preexposure and environmental preexposure determines subsequent learning. Journal of Experimental Psychology: Animal Behavior Processes, 90, 190-197.

Macfarlane, A. (1977). The psychology of childbirth. Cambridge: Harvard University Press.

Mackay, B. (1974). Conditioned food aversions produced by toxicosis in Atlantic cod. Behavioral Biology, 12, 347-355.

Martin, G.M., & Bellingham, W.P. (1979). Learning of visual food aversions by chickens (Gallus gallus) over long delays. Behavioral and Neural Biology, 25, 58-68.

Martin, R.C., & Melvin, K.B. (1964). Fear responses of bobwhite quail (Colinus virginianus) to a model and a live red-tailed hawk (Buetos jamaicensis). Psychologique Forschung: Zeitscrift fur Psychologie und ihre Genzwissenschaften, 27, 323-336.

Maslow, A.H. (1932). The "emotion" of disgust in dogs. Journal of Comparative Psychology, 14, 401-407.

McCarron, D.A., Morris, C.D., & Cole, C. (1982). The retina of the newborn infant. Science, 217, 265-267.

McCarthy, D. (1935). Children's feeding problems in relation to food aversions in the family. Child Development, 6, 277-284.

Miller, H.C. (1963). The behavior of the pumpkin seed sunfish Lepomis gilbosus (Linneaus), with notes on the behavior of other species of Lepomis and pigmy sunfish, Elassoma everglade. Behaviour, 22, 88-151.

Miller, R.R., & Holzman, A.D. (1981a). Neophobia: Generality and function. Behavioral and Neural Biology, 33, 17-44.

Miller, R.R., & Holzman, A.D. (1981b). Neophobias and conditioned taste aversions in rats following exposure to novel flavors. Animal Learning and Behavior, 9(1), 89-100.

Misanin, J.R., Blatt, L.A., & Hinderliter, C.F. (1985). Age dependency in neophobia: Its influence on taste-aversion learning and the flavor-preexposure effect in rats. Animal Learning and Behavior, 13, 69-76.

Misanin, J.R., Guanowsky, V., & Riccio, D.C. (1983). The effect of CS-preexposure on conditioned taste aversion in young and adult rats. Physiology and Behavior, 30, 859-862.

Mistretta, C.M., & Bradley, R.M. (1977). Taste in utero: Theoretical considerations. In J.M. Weiffenbach (Ed.), Taste and development: The genesis of sweet preference (pp. 51-69). Bethesda,Md.: U.S. Department of Health, Education and Welfare.

Mitchell, D. (1976). Experiments on neophobia in wild and laboratory rats: a reevaluation. Journal ofComparative and Physiological Psychology, 90(3), 190-197.

Mitchell, D. (1978). The psychological vs. the ethological rat: Two views of the poison avoidance behavior of the rat compared. Animal Learning and Behavior, 6, 121-124.

Mitchell, D., Fairbanks, M., & Laycock, J.D. (1977). Suppression of neophobia by chlorpromazine in wild rats. Behavioral Biology, 19, 309-323.

Mitchell, D.. Kirschbaum, E.H., & Perry, R.L. (1975). Effects of neophobia and habituation on the poison-induced avoidance of exteroceptive stimuli in the rat. Journal of Experimental Psychology: Animal Behavior Processes, 104, 47-55.

Mitchell, D., Osborne, E.W., & O'Boyle, M.W. (1985). Habituation under stress: Shocked mice show nonassociative learning in a T-maze. Behavioral and Neural Biology, 43, 212-217.

Mitchell, D., Scott D.W., & Williams, K.D. (1973). Container neophobia and the rat's preference for earned food. Behavioral Biology, 9, 612-624.

Mitchell, D., Yin, M., & Nakamatsu, K. (1980). Context habituation and taste neophobia: Evidence for a cross-modality contrast effect. Behavioral and Neural Biology, 29, 117-122.

Mitchell, D., Winter, W., & Moffitt, T. (1980). Cross-modality contrast: Exteroceptive context habituation enhances taste neophobia and conditioned taste aversions. Animal Learning and Behavior, 8(4), 524-528.

Molina, J.C., Hoffmann, H., & Spear, N.E. (1985). Conditioning of aversion to alcohol orosensory cues in 5- and 10-day old rats: Subsequent reduction in alcohol ingestion. Developmental Psychobiology, 19, 175-183.

Molina, J.C., Serwatka, J., & Spear, N.E. (1984). Changes in alcohol intake resulting from prior experience with alcohol odor in young rats. Pharmacology, Biochemistry, and Behavior, 21, 387-391.

Molina, J.C., Serwatka, J., Spear, L.P., & Spear, N.E. (1985). Differential ethanol olfactory experiences affect ethanol ingestion in preweanlings but not in older rats. Behavioral and Neural Biology, 44, 90-100.

Mook, D.G. (1987). Motivation: The organization of action (pp.70,85-86). New York: W.W. Norton & Co.

Morrell, G.M., & Turner, J.R.G. (1970). Experiments on mimicry, I. The response of wild birds to artificial prey. Behaviour, 36, 116-130.

Moss, E., & Harlow, H. (1947). The role of reward in the discrimination learning of monkeys. Journal of Comparative and Physiological Psychology, 40, 333-342.

Munsinger, H., & Kessen, W. (1964). Uncertainty, structure, and preference. Psychological Monograph, 78(9), Whole No. 586.

Nachman, M., & Jones, D.R. (1974). Learned taste aversion over long delays in rats: The role of learned safety. Journal of Comparative and Physiological Psychology, 86, 949-956.

Navarick, D.J., & Strouthes, A. (1969). Relative intake of saccharin drinking schedule. Psychonomic Science, 15, 158-159.

Olson, C.L. (1987). Statistics: Making sense of data. Boston: Allyn & Bacon, Inc.

Palmer, S., & Horn, S. (1978). Feeding problems in children. In S. Palmer and S. Ekvall (Eds.), Pediatric nutrition in developmental disorders (pp.107-129). Springfield, Ill.: Charles C. Thomas.

Pelchat, M.L., & Pliner, P. (1986). Antecedents and correlates of feeding problems in young children. Journal of Nutrition Education, 18, 23-29.

Pfaffman, C., Norgren, R., & Grill, H. (1977). Sensory affect and motivation. Annals of the New York Academy of Sciences, 290, 18-34.

Piaget, J. (1952). The origins of intelligence in children (trans. by M. Cook). New York: Internat. Univ. Press.

Pliner, P. (1982). The effect of mere exposure on liking for edible substances. Appetite, 3, 283-290.

Pliner, P. (1983). Family resemblance in food preference. Journal of Nutrition Education, 15, 137-140.

Putallaz, M. (1987). Maternal behavior and children's sociometric status. Child Development, 58, 324-370.

Rabinowitch, V. (1961). A study of the effect of early experience on stereotyped food habits in the domestic chicken. Unpublished M.S. thesis, University of Wisconsin, Madison, Wisconsin.

Rabinowitch, V. (1968). The role of experience in the development of food preferences in gull chicks. Animal Behavior, 16(4), 425-428.

Rabinowitch, V. (1969). The role of experience in the development and retention of seed preferences in zebra finches. Behaviour, 33(3-4), 222-236.

Rachman, S., & Hodgson, R. (1974). Synchrony and desynchrony in fear and avoidance. Behaviour Research and Therapy, 12, 311-318.

Reardon, P., & Bushnell, E.W. (1988). Infants' sensitivity to arbitrary pairings of color and taste. Infant Behavior and Development, 11, 245- 250.

Richter, C.P. (1953). Experimentally produced behavior reactions to food poisoning in wild and domesticated rats. <u>Annals of the New York Academy of Sciences</u>, <u>56</u>, 225-239.

Riordan, M.M., Iwata, B.A., Finney, J.W., Wohl, M.K., & Stanley, A.E. (1984). Behavioral assessment and treatment of chronic food refusal in handicapped children. <u>Journal of Applied Behavior Analysis</u>, <u>17</u>(3), 327-341.

Roper, T.J. (1990). Responses of domestic chicks to artificially coloured insect prey: effects of previous experience and background color. <u>Animal Behavior</u>, <u>39</u>, 466-473.

Rothschild, M. (1985). British aposematic lepidoptera. In J. Heath & A.M. Emmett (Eds.), <u>The moths and butterflies of Great Britain and Ireland</u>, (pp. 9-62). Colchester, Essex: Harley.

Rozin, P. (1976). The selection of foods by rats, humans, and other animals. In J. Rosenblatt, R.A. Hinde, C. Beer, & E. Shaw (Eds.), <u>Advances in the Study of Behavior</u> (Vol. 6, pp. 21-76). New York: Academic Press.

Rozin, P. (1977). The significance of learning mechanisms in food selection: Some biology, psychology and sociology of science. In L.M. Barker, M.R. Best, & M. Domjan (Eds.), <u>Learning mechanisms in food selection</u> (pp. 557-589). Waco, Tx.: Baylor Univeristy Press.

Rozin, P. (1990a). Development in the food domain. <u>Developmental Psychology</u>, <u>26</u>(4), 555-562.

Rozin, P. (1990b). The importance of social factors in understanding the acquisition of food habits. In E.D. Capaldi and T.L. Powley (Eds.), <u>Taste, experience, and feeding</u> (pp. 255-269). Washington,D.C.: American Psychological Asso.

Rozin, P., & Fallon, A. (1980). The psychological categorization of foods and non-foods: A preliminary taxonomy of food rejections. <u>Appetite</u>, <u>1</u>, 193-201.

Rozin, P., & Fallon, A. (1981). The acquisition of likes and dislikes for foods. In J. Solms & R.H. Hall (Eds.), <u>Criteria of food acceptance: How man chooses what he eats</u> (pp. 35-48). Zurich: Fuster.

Rozin, P., Fallon, A.E., & Mandell, R. (1984). Family resemblance in attitudes to food. Developmental Psychology, 20, 309-314.

Rozin, P., & Kalat, J. (1972). Learning as a situation-specific adaptation. In M.E.P. Seligman and J. Hager (Eds.), The Biological Boundaries of Learning (pp. 66-97). New York: Appleton.

Rozin, P., Hammer, L., Oster, H., Horowitz, T., & Marmara, V. (1986). The child's conception of food: differentiation of categories of rejected substances in the 1.4 to 5 year age range. Appetite, 7, 141-151.

Rudy, J.W., Rosenberg, L., & Sandell, J.H. (1977). Disruption of a taste familiarity effect by novel exteroceptive stimulation. Journal of Experimental Psychology: Animal Behavior Processes, 3(1), 26-36.

Rudy, J.W., Vogt, M.B., & Hyson, R.L. (1984). A developmental analysis of the rat's learned reactions to gustatory and auditory stimulation. In R. Kail and N.E. Spear (Eds.), Comparative perspectives on the development of memory. Hillsdale, N.J.: Lawrence Erlbaum Asso.

Rusiniak, K.W., Hankins, W.G., Garcia, J., & Brett, L.P. (1979). Flavor-illness aversions: Potentiation of odor by taste in rats. Behavioral and Neural Biology, 25, 1-17.

Rzoska, J. (1953). Bait shyness, a study in rat behavior. British Journal of Animal Behaviour, 1, 128-135.

Salapatek, P. (1975). Pattern perception in early infancy. In L.B. Cohen and P. Salapatek (Eds.), Basic visual processes: Vol. 1. Infant perception: From sensation to cognition. New York: Academic Press.

Schleidt, W. (1961a). Reaktionen von truthuhnern auf fliegende raubvogel und versuche zur analyse ihrer AAM's. Zeitschrift fur Tierpsychologie, 18, 534-560.

Schleidt, W. (1961b). Uber die auslosung der flucht vor raubvogeln bei truthuhnern. Naturwissenschaften, 48, 141-142.

Schneirla, T.C. (1939). A theoretical consideration of the basis for approach-withdrawal adjustments in behavior. Psychological Bulletin, 37, 501-502.

Schneirla, T.C. (1957). The concept of development in comparative psychology. In D.B. Harris, (Ed.). The concept of development: An issue in the study of human behavior (pp. 59-77). Minneapolis: Univ. of Minnesota Press.

Schneirla, T.C. (1959). An evolutionary and developmental theory of biphasic processes underlying approach and withdrawal. In M.R. Jones (Ed.), Current theory and research on motivation (Vol. 7, pp. 1-42). Lincoln: University of Nebraska Press.

Schneirla, T.C. (1965). Aspects of stimulation and organization in approach/withdrawal processes underlying vertebrate behavioral development. In D.S. Lehrman, R.A. Hinde, and E. Shaw (Eds.), Advances in the study of behavior (Vol.1). New York: Academic Press.

Scott, E.M. (1946). Self-selection of diet: I. Selection of purified components. Journal of Nutrition, 31, 397-406.

Serwatka, J., Molina, J.C., & Spear, N.E. (1986). Weanlings' transfer of conditioned ethanol aversion from olfaction to ingestion depends on the unconditioned stimulus. Behavioral and Neural Biology, 45, 57-70.

Shafer, D. R. (1989). Developmental Psychology, (2ndEd.) (pp. 196-227). Pacific Grove, Calif.: Brooks-Cole Publishing Co.

Sheffield, F.D., & Roby, T.B. (1950). Reward value of non-nutritive sweet taste. Journal of Comparative and Physiological Psychology, 43, 471-482.

Sheldon, A.B. (1969). Preference for familiar versus novel stimuli as a function of the familiarity of the environment. Journal of Comparative and Physiological Psychology, 67, 516-521.

Shettleworth, S.J. (1972). The role of novelty in learned avoidance of unpalatable 'prey' by domestic chicks (Gallus Gallus). Animal Behavior, 20, 29-35.

Shorten, M. (1954). The reaction of the brown rat towards changes in its environment. In D. Chitty (Ed.), Control of rats and mice (Vol.2). Oxford: Claredon Press.

Siegel, S. (1974). Flavor preexposure and "learned safety". Journal of Comparative and Physiological Psychology, 87(6), 1073-1082.

Singh, D. (1974). Role of preoperative experience on reaction to quinine taste in hypothalamic hyperphagic rats. Journal of Comparative and Physiological Psychology, 86, 674-678.

Smith, S.M. (1975). Innate recognition of coral snake pattern by a possible avian predator. Science, 187, 759-760.

Smith, G.J., Kucharski, D., & Spear, N.E. (1985). Ontogenetic differences in the conditioning of an odor aversion using isolation from the home nest environment as the unconditioned stimulus. Developmental Psychobiology, 18, 421-434.

Smock, C.D., & Holt, B.G. (1962). Children's reactions to novelty: An experimental study of "curiosity motivation". Child Development, 33, 631-642.

Spear, N.E., & Campbell, B.A. (1979). Ontogeny of learning and memory. Hillsdale, N.J.: Lawrence Erlbaum Asso.

Spear, N.E., & Kucharski, D. (1984). Ontogenetic differences in stimulus selection during conditioning. In R. Kail and N.E. Spear (Eds.), Comparative perspectives on the development of memory. Hillsdale, N.J.: Lawrence Erlbaum Asso.

Spear, N.E., & Molina, J.C. (1987). The role of sensory modality in the ontogeny of stimulus selection. In N.A. Krasnegor, E.M. Blass, M.A. Hofer, and W.P. Smotherman (Eds.), Perinatal development: A psychobiological perspective (pp. 83-110). Orlando, FL: Academic Press.

Steiner, J.E. (1973). The gustofacial response: observation on normal and anancephalic new-born infants. In J.F. Bosma (Ed.), 4th Symposium on oral sensation and perception. Bethesda, Maryland, N.I.H.

Steiner, J.E. (1977). Facial expressions of the neonate infant indicating the hedonics. In J.M.Weiffenbach (Ed.), Taste and development: The genesis of sweet preference (pp. 173-189). Bethesda, Md.: U.S. Dept. of H.E.W..

Steiner, J.E. (1979a). Human facial expressions in response to taste and smell stimulation. In L.P. Lipsitt and H.W. Reese (Eds.), Advances in Child Development and Behavior (Vol. 13, 257-295). New York: Academic Press.

Steiner, J.E. (1979b). Oral and facial innate motor responses to gustatory and to some olfactory stimuli. In J.H.A. Kroetze (Ed.), Preference Behaviour and Chemoreception; Proceedings of a symposium organised by the European Chemoreception Research Organization at "Het Meerdal", Horst, The Netherlands 15th to 17th May, 1979 (pp. 247-261). London: Information Retrieval Limited.

Stern, D. (1977). The first relationship. Cambridge: Harvard University Press.

Switzky, H.N., Haywood, H.C., & Isett, R. (1974). Exploration, curiosity, and play in young children: Effects of stimulus complexity. Developmental Psychology, 10, 321-329.

Tarpy, R.M., & McIntosh, S.M. (1977). Generalized latent inhibition in taste-aversion learning. Bulletin of the Psychonomic Society, 10(5), 379-381.

Termine, N.T., & Izard, C.E. (1988). Infants' responses to their mothers' expressions of joy and sadness. Developmental Psychology, 24, 223-229.

Thomas, H. (1966). Preference for random shapes: Age six through nineteen years. Child Development, 37, 843-859.

Thomas, A., & Chess, S. (1977). Temperament and development. New York: Brunner/Mazel.

Thompson, R.F., Groves, P.M., Teyler, T.J.. & Roemer, R.A. (1973). A dual-process theory of habituation: Theory and behavior. In H.V.S. Peeke and M.J. Herz (Eds.), Habituation. New York: Academic Press.

Thorndike, E.L. (1898). Animal intelligence: An experimental study of the associative processes in animals. Psychological Monographs, 2(Whole No. 8).

Thorndike, E.L. (1911). Animal intelligence: Experimental studies. New York: Macmillan.

Tronick, E.Z. (1989). Emotions and emotional communication in infants. American Psychologist, 44, 112-119.

Vasquez, M., Pearson, P.B., & Beauchamp, G.K. (1982). Flavor preferences in malnourished Mexican infants. Physiology and Behavior, 28, 513-519.

Vogt, M.B., & Rudy, J.W. (1984). Ontogenesis of learning: I. Variation in the rat's reflexive and learned responses to gustatory stimulation. Developmental Psychobiology, 17(1), 11-33.

Wagner, A.R. (1976). Priming in STM: An information processing mechanism for self-generated or retrieval-generated depression in performance. In T.J. Tighe & R.N. Leaton (Eds.), Habituation: Perspectives from child development, animal behavior, and neurophysiology. Hillsdale, N.J.: Lawrence Erlbaum.

Wagner, A.R. (1978). Expectancies and the priming of STM. In S.H. Hulse, H. Fowler, & W.K. Honig (Eds.), Cognitive processes in animal behavior. Hillsdale, N.J.: Lawrence Erlbaum.

Wagner, A.R. (1979). Habituation and memory. In A. Dickinson & R.A. Boakes (eds.), Mechanisms of learning and motivation: A memorial to Jerzy Konorski. Hillsdale, N.J.: Lawrence Erlbaum.

Warren, R.P., & Pfaffman, C. (1959). Early experience and taste aversions. Journal of Comparative and Physiological Psychology, 52, 263-266.

Weiskrantz, L., & Cowey, A. (1963). The aetiology of food reward. Animal Behavior, 11, 225-234.

Weizmann, F., Cohen, L., & Pratt, J. (1971). Novelty, familiarity, and the development of infant attention. Developmental Psychology, 4, 149-154.

Wetherford, M., & Cohen, L. (1971). Developmental changes in infant visual preferences. Paper presented at Society for Research in Child Development Meetings, Minneapolis.

Wigal, T., Kucharski, D., & Spear, N.E. (1984). Familiar contextual odors promote discrimination learning in preweanling but not in older rats. Developmental Psychobiology, 17, 555-570.

Wilcoxin, H.C., Dragoin, W.B., & Kral, P. (1971). Illness-induced aversions in rat and quail: Relative salience of visual and gustatory cues. Science, 171, 826-828.

Yerkes, R.M. (1913). The heredity of savageness and wildness in rats. Journal of Animal Behavior, 3, 286-296.

Young, P.T. (1944). Studies of food preference, appetite, and dietary habit. I. Running activity and dietary habit of the rats in relation to food preference. Journal of Comparative and Physiological Psychology, 37, 327-370.

Zeaman, D. (1976). The ubiquity of novelty-familiarity (habituation?) effects. In T.J. Tighe & R.N. Leaton (Eds.), Perception, cognition, and development: Interactional analyses. Hillsdale, N.J.: Lawrence Erlbaum Asso, Pub.

Zeaman, D., & Hanley, P. (1983). Stimulus preferences as structural features. In T.J. Tighe and B.E. Shepp (Eds.), Perception, cognition, and development: Interactional analyses (pp. 103-128). Hillsdale, N.J.: Lawrence Erlbaum Asso, Pub.

Zeskind, P.S., & Ramey, C. T. (1978). Fetal malnutrition: An experimental study of its consequences on infant development in two caregiving environments. Child Development, 49, 1155-1162.

Zeskind, P.S., & Ramey, C. T. (1981). Preventing intellectual and interactional sequelae of fetal malnutrition: A longitudinal, transactional, and synergistic approach to development. Child Development, 52, 213-218.

Appendix A

Cover Letter

date

Dear Parent,

I am a doctoral student in Developmental Psychology at Virginia Tech studying the development of food acceptance in infants and toddlers. For my dissertation, I am studying why some children, by about age two, may refuse to try new foods. Infants at 6 months seem to eat almost anything, even some things that they shouldn't. Studies show that by age 2, some toddlers prevent themselves from receiving an adequate diet.

The enclosed Statement of Informed Consent describes the procedures of the study. Infants and toddlers will be presented with a familiar or a novel food during their routine lunch period. The food may be presented by a familiar caretaker or by an unfamiliar experimenter. The new food will be palatable and could include cooked pumpkin, butternut squash, carrot or sweet potato- cut into small cubes, or jello made with water or apricot nectar and served in blocks. I hope you will allow your child to participate in this study. The procedures will present no risks or discomforts to your child. ____[day-care center]____ , the Human Subjects Committee of the Department of Psychology and the Internal Reveiw Board of Virginia Tech have approved this study.

To help determine what foods are familiar or unfamiliar to your child, you will be asked to complete the enclosed checklist of foods.

At the completion of the study, you will receive a summary of the findings.

Thank you,

Lera Joyce Johnson

Further information concerning the study or the review process is available from the following people:

Lera Joyce Johnson, Graduate Student
703-953-0026

Dr. Joseph J. Franchina, Department of Psychology
703-231-5664

Dr. Ernest Stout, Chairman, Internal Review Board
703-231-9359

Dr. Helen Crawford, Chairperson, Human Subjects Committee, Department of Psychology
703-231-6581

Appendix B

Statement of Informed Consent

Statement of Informed Consent

This study will examine the effects of a novel tasting food cues and novel presenter on initiation and continuation of eating in infants and toddlers. The procedure entails offering a familiar tasting or a novel tasting food by a familiar or an unfamiliar presenter. The unfamiliar presenter will be an experimenter whom the child does not know.

About 1/2 cup of the pre-selected food will be presented to the child before his/her routine lunch. If the infant or toddler does not accept the first bite of food after two minutes, a small amount of the food will be placed on the child's lips. The child will not be forced to taste, eat or swallow. The child will be allowed to eat the full serving of food. Leftovers will be discarded. The procedure minimizes risk to your child. You have the right to withdraw your child from participation at any time.

An experimenter will videotape the child's reaction to the food presentation. The videotapes will be retained as data until the completion of the study. The child's identity will remain anonymous and confidential. Data collected from the study will be presented only at professional meetings or in professional journals. After the data have been recorded onto the computer for statistical analyses, the videotapes will be destroyed.

This study has been reviewed and approved by the Internal Review Board of Virginia Polytechnic Institute and State University and the Human Subjects Committee of the Department of Psychology. Further information concerning the study or the review process is available from the following people:

Lera Joyce Johnson, Graduate Student
703-953-0026

Dr. Joseph J. Franchina, Department of Psychology
703-231-5664

Dr. Ernest Stout, Chairman, Internal Review Board
703-231-9359

Dr. Helen Crawford, Chairperson, Human Subjects Committee, Department of Psychology
703-231-6581

I have read and understand the Statement of Informed Consent and hereby give permission for my child, ________________, to participate in the study as described.

____

Date_____________________________

If you want to know before the testing date what food has been selected, please indicate below by giving your phone number, who to ask for and the best time to call.

Whom___________________ Phone____________[work___home____] Best time to call____

Appendix C

Food Checklist

Food Checklist

Please state your child's:

Age in months________

Please indicate your child's gender:

______Male ______Female

Was this child breastfed? ____No ____Yes If yes, for how long? ______mo.

At what age were solid foods introduced? ____mo.

Place a check beside each food listed below which your child has ever tasted. At the bottom of the sheet, list any food which your child has tasted which was not on this list.

Please specify if your child has any known food allergies.

_______	graham crackers	______	Ritz crackers
_______	zwieback toast	______	melba toast
_______	cheerios	______	banana
_______	pear	______	peaches
_______	white potato	______	sweet potato
_______	peas	______	carrots
_______	raisins	______	rice
_______	applesauce, apples	______	pineapple
_______	jello blocks (red)	______	apricot nectar
_______	cheese (yellow)	______	cheese (white)
_______	yogurt	______	corn
_______	oatmeal	______	pumpkin
_______	butternut squash	______	yellow squash
_______	vanilla pudding	______	green beans
_______	lima beans	______	kidney beans

Please list in the space below any other foods that your child has tasted:

Please state any known food allergies in the space below:

Is there a history of food allergies in the immediate family? ____No ____Yes If yes, please state in the space below who is allergic, their relationship to the child, and to what food groups.

Appendix D

Rating Sheet

Behavioral Response Observation Record   Subject Number_ ______

Tape number: ______Counter location on tape: ______ - _______

Latency to first touch of food: ____________(sec)

Latency (sec) to bite 1: __________ to bite 2: ____ __________

Indicate the frequency of each discrete behavior by placing a hash mark beside each category as the behavior occurs. Summarize the count for each bite at the end of the session.

Behavior	Prior to Food Deliv.	Sum	Pre-bite 1	Sum	Pre-bite 2	Sum
Spits out food						
Pushes food away						
Flexor resp upper extremeties						

Indicate the hedonic tone of facial expressions during each time period by writing the number closest to that value. More than one number may be recorded in each time period if expressions change. In the PCT column, write the percent of frequency each number was recorded during the period.

Extrmly Pos.	Very Pos.	Pos.	Slightly Pos.	Neut'l	Slightly Neg.	Neg.	Very Neg.	Extrmly Neg.
1	2	3	4	5	6	7	8	9

	Prior to Food Deliv.	PCT	Pre-bite 1	PCT	Pre-bite 2	PCT
Expression						

Rater (Name and code): __ ______________________   Form A

Appendix E

Summary Tables of Means and Analyses of Variance:

Tables 1E-23E

Table 1-E

Number of Subjects in Each Cell in Each Age Group Which Received Familiar (FAM) or Novel (NOV) Food from a Familiar or Novel Presenter

AGE : INFANT

	PRESENTER CONDITION	
FOOD CONDITION	FAM	NOV
FAM	8	10
NOV	7	7

AGE : TODDLER

	PRESENTER CONDITION	
FOOD CONDITION	FAM	NOV
FAM	8	8
NOV	7	9

Table 2-E

Summary of Univariate and F Max Tests on Raw Dependent Variable Data Before and After Transformation

Latency Data

	Bite 1 Raw	Bite 1 Log 10	Bite 2 Raw	Bite 2 Log 10
Skewness	0.93	-0.28	0.87	0.03
Kurtosis	-0.58	-1.10	-0.86	-1.37
F Max	7.77**	9.06**	57.74**	7.80**

Gustofacial Data- POS, NEU, NEG / VPOS, SPOS, NEU, SNEG, VNEG

	POS, NEU, NEG Pre-Sessn	POS, NEU, NEG Prior Bite 1	POS, NEU, NEG Prior Bite 2	VPOS,SPOS,NEU,SNEG,VNEG Pre-Sessn	VPOS,SPOS,NEU,SNEG,VNEG Prior Bite 1	VPOS,SPOS,NEU,SNEG,VNEG Prior Bite 2
Skewness	0.72	0.44	0.49	0.96	1.52	1.52
Kurtosis	-1.00	-1.36	-1.65	-0.97	0.84	0.93
F Max	1.56	1.64	1.81	1.42	1.37	1.51

Behavioral Data

RAW:	Spit Bite2	Push Bite1	Push Bite2	Flex Pre-	Flex Bite1	Flex Bite2
Skewness	3.98	7.00	5.27	8.00	4.08	4.32
Kurtosis	16.78	52.51	33.38	64.00	16.28	18.45
F Max	2.07	126.22**	66.67**	x	10.67**	4.57*
TRANS: Square Root	Spit Bite2	Push Bite1	Push Bite2	Flex Pre-	Flex Bite1	Flex Bite2
Skewness	3.38	4.20	2.43	8.00	3.36	3.89
Kurtosis	10.25	20.68	6.52	64.00	10.49	14.06
F Max	1.11	10.78**	6.67*	x	2.67	3.43

Intake Data

	Gross Intake	Percent Intake
Skewness	2.52	2.00
Kurtosis	6.99	4.35
F Max	26.92**	22.32**

* $p < .05$ ** $p < .01$

Table 3-E

Summary of Means (With Standard Deviations) and ANOVA of Latencies (sec) to First Bite for Age Groups Which Received Familiar (FAM) or Novel (NOV) Food From a Familiar or Novel Presenter

Source			df	SS	F
AGE			1	5568.9	0.79
INF		74.3 (75.3)			
TOD		92.9 (95.5)			
FOOD			1	2829.4	0.40
AGE X FOOD			1	12553.1	1.78
INF	FAM	67.7 (62.8)			
	NOV	82.7 (90.7)			
TOD	FAM	113.6 (96.9)			
	NOV	72.3 (92.5)			
PRESENTER			1	43844.3	6.22*
AGE X PRESENTER			1	192.4	0.03
INF	FAM	48.7 (40.4)			
	NOV	96.8 (91.7)			
TOD	FAM	64.7 (95.2)			
	NOV	117.9 (91.3)			
FOOD X PRESENTER			1	20.0	0.00
AGE X FOOD X PRESENTER			1	4402.8	0.62
Error			56	394912.4	

* $p < .05$

Table 4-E

Summary of Means (With Standard Deviations) of Each Factor and ANOVA of Latencies (sec) to Second Bite for Age Groups Which Received a Familiar (FAM) or Novel (NOV) Food From a Familiar or Novel Presenter

Source	df	SS	F
AGE	1	36768.1	5.19*
INF 64.1 (75.9)			
TOD 112.0 (95.6)			
FOOD	1	184.5	0.03
AGE X FOOD	1	5690.5	0.80
INF FAM 54.2 (60.1)			
NOV 76.7 (93.3)			
TOD FAM 119.7 (93.6)			
NOV 104.3 (100.1)			
PRESENTER	1	53000.0	7.49**
AGE X PRESENTER	1	2265.6	0.32
INF FAM 27.8 (28.6)			
NOV 96.1 (90.2)			
TOD FAM 88.3 (101.0)			
NOV 132.9 (88.4)			
FOOD X PRESENTER	1	629.2	0.09
AGE X FOOD X PRESENTER	1	4064.7	0.57
Error	56	396453.4	

* $p < .05$ ** $p < .01$

Table 5-E

Summary of Repeated Measures ANOVA of Latencies (sec) to First and Second Bites (BITE) for Age Groups Which Received Familiar or Novel Food From a Familiar or Novel Presenter

Source	df	SS	F
FOR BETWEEN SUBJECTS EFFECTS			
AGE	1	32464.5	2.55
FOOD	1	734.6	0.06
AGE X FOOD	1	21119.5	1.66
PRESENTER	1	99979.9	7.86**
AGE X PRESENTER	1	947.9	0.07
FOOD X PRESENTER	1	462.6	0.04
AGE X FOOD X PRESENTER	1	8464.1	0.67
Error	56	712588.6	
FOR WITHIN SUBJECTS EFFECTS			
BITE	1	636.5	0.45
BITE X AGE	1	6819.4	4.85*
BITE X FOOD	1	2355.6	1.67
BITE X AGE X FOOD	1	618.9	0.44
BITE X PRESENTER	1	239.5	0.17
BITE X AGE X PRESENTER	1	1936.1	1.38
BITE X FOOD X PRESENTER	1	212.1	0.15
BITE X AGE X FOOD X PRES	1	3.4	0.00
Error	56	78777.2	

* $p < .05$ ** $p < .01$

Table 6-E

Summary of Means (With Standard Deviations) and ANOVA of Latencies (sec) to Second Bite for Age Groups Which Received Combinations of Familiar (FAM) or Novel (NOV) Food and Familiar or Novel Presenter

Source		df	SS	F
AGE		1	36768.1	5.19*
INF	64.1 (75.9)			
TOD	112.0 (95.6)			
COND (Pres/Food)		3	51451.0	2.42
FF	59.3 (78.2)			
NF	107.9 (83.1)			
FN	56.6 (83.1)			
NN	121.9 (99.2)			
AGE X COND		3	14383.4	0.68
Error		56	396453.4	

* $p < .05$

Table 7-E

Summary of ANOVA of Percentage Time That a Negative Expression Was Observed in Age Groups Which Received a Familiar or Novel Food

Source	df	SS	F
AGE	1	937.9	1.84
FOOD	1	176.1	0.34
AGE X FOOD	1	766.3	1.50
Error	60	30630.4	

Note. 3-Point Expression Scale

Table 8-E

Summary of ANOVA of Percentage Time That a Slightly Negative (SNEG) or Very Negative (VNEG) Expression Was Observed in Age Groups Which Received a Familiar or Novel Food

VAR: SNEG

Source	df	SS	F
AGE	1	1207.6	2.60
FOOD	1	93.1	0.20
AGE X FOOD	1	577.4	1.24
Error	60	29797.0	

VAR: VNEG

Source	df	SS	F
AGE	1	17.0	0.99
FOOD	1	13.1	0.77
AGE X FOOD	1	13.3	0.78
Error	60	1028.5	

Note. 5-Point Expression Scale

Table 9-E

Summary of Repeated Measures ANOVA of Percentage Time Prior to the First and Second Bites (BITE) That Negative Expressions Were Observed in Age Groups Which Received Familiar or Novel Food

Source	df	SS	F
FOR BETWEEN SUBJECTS EFFECTS			
AGE	1	802.4	1.66
FOOD	1	1302.7	2.69
AGE X FOOD	1	130.9	0.27
Error	60	29059.6	
FOR WITHIN SUBJECTS EFFECTS			
BITE	1	140.0	0.39
BITE X AGE	1	340.5	0.95
BITE X FOOD	1	289.6	0.81
BITE X AGE X FOOD	1	767.6	2.13
Error	60	21586.0	

Note. 3-Point Expression Scale

Table 10-E

Summary of Repeated Measures ANOVA of Percentage Time Prior to the First and Second Bites (BITE) That Slightly Negative (SNEG) Expressions Were Observed in Age Groups Which Received Familiar or Novel Food

Source	df	SS	F
FOR BETWEEN SUBJECTS EFFECTS			
AGE	1	1039.4	2.26
FOOD	1	1035.6	2.25
AGE X FOOD	1	56.7	0.12
Error	60	27615.4	
FOR WITHIN SUBJECTS EFFECTS			
BITE	1	112.0	0.35
BITE X AGE	1	388.3	1.21
BITE X FOOD	1	333.8	1.04
BITE X AGE X FOOD	1	699.8	2.18
Error	60	19218.4	

Note. 5-Point Expression Scale

Table 11-E

Summary of Repeated Measures ANOVA of Percentage Time Prior to the First and Second Bites (BITE) That Very Negative (VNEG) Expressions Were Observed in Age Groups Which Received Familiar or Novel Food

Source	df	SS	F
FOR BETWEEN SUBJECTS EFFECTS			
AGE	1	15.3	1.48
FOOD	1	15.3	1.48
AGE X FOOD	1	15.3	1.48
Error	60	619.6	
FOR WITHIN SUBJECTS EFFECTS			
BITE	1	1.6	0.14
BITE X AGE	1	1.6	0.14
BITE X FOOD	1	1.6	0.14
BITE X AGE X FOOD	1	1.6	0.14
Error	60	681.9	

Note. 5-Point Expression Scale

Table 12-E

Summary of Repeated Measures ANOVA of Percentage Time Prior to the First and Second Bites (BITE) That Negative Expressions Were Observed in Age Groups Which Received a Familiar or Novel Food or Presenter

Source	df	SS	F
FOR BETWEEN SUBJECTS EFFECTS			
AGE	1	765.4	1.49
FOOD	1	1335.1	2.60
AGE X FOOD	1	122.4	0.24
PRESENTER	1	29.1	0.06
AGE X PRESENTER	1	257.9	0.50
FOOD X PRESENTER	1	46.0	0.09
AGE X FOOD X PRESENTER	1	0.0	0.00
Error	56	28731.5	
FOR WITHIN SUBJECTS EFFECTS			
BITE	1	134.0	0.35
BITE X AGE	1	337.7	0.89
BITE X FOOD	1	287.2	0.76
BITE X AGE X FOOD	1	750.6	1.98
BITE X PRESENTER	1	204.8	0.54
BITE X AGE X PRES	1	14.9	0.04
BITE X FOOD X PRES	1	14.7	0.04
BITE X AGE X FOOD X PRES	1	113.1	0.30
Error	56	21242.5	

Note. 3-Point Expression Scale

Table 13-E

<u>Pearson Product Moment Correlations Between First Bite Latencies and Percentage Time of Gustofacial Expressions on 3- and 5-Point Scales and Behavioral Indices By Age Groups</u>

	POS	SPOS	NEU	FLEX	PUSH
Infants B1					
	.67***	.59***	-.62***	.37*	.06
Toddlers B1					
	.51**	.51**	-.41*	.43*	.41*

*** $p < .001$ ** $p < .01$ * $p < .05$

Table 14-E

Summary of ANOVA of Percentage Time That Gustofacial Expressions (POSitive, NEUtral, NEGative) Were Observed Prior to the First Bite for Age Groups Which Received a Familiar or Novel Food From a Familiar or Novel Presenter

Source	df	SS	F
Type III SS			
AGE	1	0.0	0.28
FOOD/PRES COND	3	0.0	2.48
AGE X FOOD/PRES COND	3	0.0	0.47
SUBJect(FOOD/PRES COND)	8	0.0	
EXPression	2	20334.3	8.94**
POS 17.0 %			
NEU 75.5 %			
NEG 7.4 %			
EXP X AGE	2	5257.7	2.31
EXP X FOOD/PRES COND	6	11693.3	1.71
EXP X AGE X FOOD/PRES	6	1706.8	0.25
SUBJ X EXP(FOOD/PRES)	16	13383.7	
Error	144	89308.7	

Note. 3-Point Expression Scale
** $p < .01$

Table 15-E

Summary of ANOVA of Percentage Time That Gustofacial Expressions (Very or Slightly POSitive, NEUtral, Slightly or Very NEGative) Were Observed Prior to the First Bite for Age Groups Which Received a Familiar or Novel Food or Presenter

Source	df	SS	F
Type III SS			
AGE	1	0.9	7.39*
INF 19.7 %			
TOD 19.9 %			
FOOD/PRES COND	3	10.4	27.56***
FAM FOOD			
FAM PRES 20.0 %			
NOV PRES 20.0 %			
NOV FOOD			
FAM PRES 20.0 %			
NOV PRES 19.1 %			
AGE X FOOD/PRES COND	3	2.2	5.79*
INF: FAM FOOD FAM PRES 20.0 %		TOD: FAM FOOD FAM PRES 20.0 %	
NOV PRES 20.0 %		NOV PRES 20.0 %	
INF: NOV FOOD FAM PRES 20.0 %		TOD: NOV FOOD FAM PRES 20.0 %	
NOV PRES 18.4 %		NOV PRES 19.7 %	
SUBJect(FOOD/PRES COND)	8	1.0	
EXPression	4	33474.4	14.67***
VPOS 0.2 %			
SPOS 15.7 %			
NEU 75.5 %			
SNEG 7.2 %			
VNEG 0.3 %			
EXP X AGE	4	5431.6	2.38
EXP X FOOD/PRES COND	12	11795.0	1.72
EXP X AGE X FOOD/PRES	12	1599.6	0.23
SUBJ X EXP(FOOD/PRES)	32	18256.1	
Error	240	82080.7	

Note. 5-Point Expression Scale

* *p* < .05 ** *p* < .01 *** *p* < .001

Table 16-E

Summary of Means (With Standard Deviations) of Each Factor and ANOVA of Frequencies of Upper Body Flexions Prior to the First Bite for Age Groups Which Received Familiar (FAM) or Novel (NOV) Food From a Familiar or Novel Presenter

Source		df	SS	F
AGE		1	0.1	0.09
INF	0.3 (1.0)			
TOD	0.2 (0.6)			
FOOD		1	0.1	0.21
AGE X FOOD		1	0.0	0.02
INF FAM	0.2 (0.9)			
NOV	0.3 (1.1)			
TOD FAM	0.1 (0.3)			
NOV	0.3 (0.8)			
PRESENTER		1	1.3	1.91
AGE X PRESENTER		1	0.6	0.85
INF FAM	0.0 (0.0)			
NOV	0.5 (1.3)			
TOD FAM	0.1 (0.4)			
NOV	0.2 (0.8)			
FOOD X PRESENTER		1	0.7	1.10
AGE X FOOD X PRESENTER		1	0.3	0.40
Error		56	37.8	

Table 17-E

Summary of Means (With Standard Deviations) of Each Factor and ANOVA of Frequencies of Pushing Away Food Prior to the First Bite for Age Groups Which Received Familiar (FAM) or Novel (NOV) Food From a Familiar or Novel Presenter

Source		df	SS	F
AGE		1	3.5	1.42
INF	0.1 (0.4)			
TOD	0.6 (2.2)			
FOOD		1	1.4	0.56
AGE X FOOD		1	3.3	1.35
INF FAM	0.2 (0.5)			
NOV	0.0 (0.0)			
TOD FAM	0.2 (0.5)			
NOV	0.9 (3.0)			
PRESENTER		1	1.2	0.49
AGE X PRESENTER		1	0.9	0.35
INF FAM	0.1 (0.3)			
NOV	0.1 (0.5)			
TOD FAM	0.3 (0.7)			
NOV	0.8 (2.9)			
FOOD X PRESENTER		1	1.5	0.59
AGE X FOOD X PRESENTER		1	1.2	0.74
Error		56	138.5	

Table 18-E

Pearson Product Moment Correlations Between Second Bite Latencies and Percentage Time of Gustofacial Expressions on 3- and 5-Point Scales and Behavioral Indices By Age Groups

	POS	VPOS	NEU	FLEX
Infants B2				
	.41*	.47**	-.54**	.40*
Toddlers B2				
	.30	.31	-.32	.35*

* $p < .05$ ** $p < .01$

Table 19-E

Summary of ANOVA of Percentage Time That Gustofacial Expressions (POSitive, NEUtral, NEGative) Were Observed Prior to the Second Bite for Age Groups Which Received a Familiar or Novel Food or Presenter

Source	df	SS	F
Type III SS			
AGE	1	1.5	0.09
FOOD/PRES COND	3	87.2	1.67
AGE X FOOD/PRES COND	3	169.3	3.25
SUBJect(FOOD/PRES COND)	8	0.0	
EXPression	2	15040.6	4.32*
POS 19.0 %			
NEU 68.3 %			
NEG 9.6 %			
EXP X AGE	2	4259.6	1.22
EXP X FOOD/PRES COND	6	11793.5	1.13
EXP X AGE X FOOD/PRES	6	14558.0	1.40
SUBJ X EXP(FOOD/PRES)	16	13383.7	
Error	144	117528.4	

Note. 3-Point Expression Scale
* $p < .05$

Table 20-E

Summary of ANOVA of Percentage Time That Gustofacial Expressions (Very or Slightly POSitive, NEUtral, Slightly or Very NEGative) Were Observed Prior to the Second Bite For Age Groups Which Received a Familiar or Novel Food or Presenter

Source	df	SS	F
Type III SS			
AGE	1	0.9	0.09
FOOD/PRES COND	3	52.3	1.67
AGE X FOOD/PRES COND	3	101.6	3.25
SUBJect(FOOD/PRES COND)	8	83.4	
EXPression	4	26921.2	7.72***
VPOS 2.3 %			
SPOS 16.7 %			
NEU 68.3 %			
SNEG 9.1 %			
VNEG 0.5 %			
EXP X AGE	4	4335.5	1.24
EXP X FOOD/PRES COND	12	11820.6	1.13
EXP X AGE X FOOD/PRES	12	15006.4	1.44
SUBJ X EXP(FOOD/PRES)	32	27879.9	
Error	240	110534.5	

Note. 5-Point Expression Scale

*** $p < .001$

Table 21-E

Summary of Means (With Standard Deviations) of Each Factor and ANOVA of Frequencies of Upper Body Flexions Prior to the Second Bite for Age Groups Which Received Familiar (FAM) or Novel (NOV) Food From a Familiar or Novel Presenter

Source		df	SS	F
AGE		1	0.1	0.40
INF	0.1 (0.5)			
TOD	0.1 (0.2)			
FOOD		1	0.0	0.03
AGE X FOOD		1	0.0	0.03
INF FAM	0.1 (0.5)			
NOV	0.1 (0.5)			
TOD FAM	0.1 (0.3)			
NOV	0.1 (0.3)			
PRESENTER		1	0.2	1.34
AGE X PRESENTER		1	0.2	1.53
INF FAM	0.0 (0.0)			
NOV	0.2 (0.7)			
TOD FAM	0.1 (0.3)			
NOV	0.1 (0.2)			
FOOD X PRESENTER		1	0.0	0.21
AGE X FOOD X PRESENTER		1	0.1	0.79
Error		56	8.8	

Table 22-E

Pearson Product Moment Correlations Between Latencies to the First and Second Bites and Intake Measures By Age Groups

	Bite 1	Bite 2
Infants	-.57***	-.64***
Toddlers	-.42*	-.49**

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 23-E

Summary of Means (With Standard Deviations) of Each Factor and ANOVA of Percentage Intake for Age Groups Which Received Familiar (FAM) or Novel (NOV) Food From a Familiar or Novel Presenter

Source		df	SS	F
AGE		1	308.4	0.60
INF	17.1 (12.4)			
TOD	21.5 (29.4)			
FOOD		1	24.7	0.05
AGE X FOOD		1	42.5	0.08
INF FAM	17.3 (10.6)			
NOV	16.9 (15.0)			
TOD FAM	20.0 (30.5)			
NOV	22.9 (29.1)			
PRESENTER		1	1319.6	2.58
AGE X PRESENTER		1	296.1	0.58
INF FAM	19.6 (11.5)			
NOV	14.9 (13.2)			
TOD FAM	28.5 (33.1)			
NOV	15.3 (25.0)			
FOOD X PRESENTER		1	500.4	0.98
AGE X FOOD X PRESENTER		1	704.8	1.38
Error		56	28651.6	

Appendix F

Figures 1-18

Mean latencies to the first bite for age groups which received a familiar or novel food or presenter.

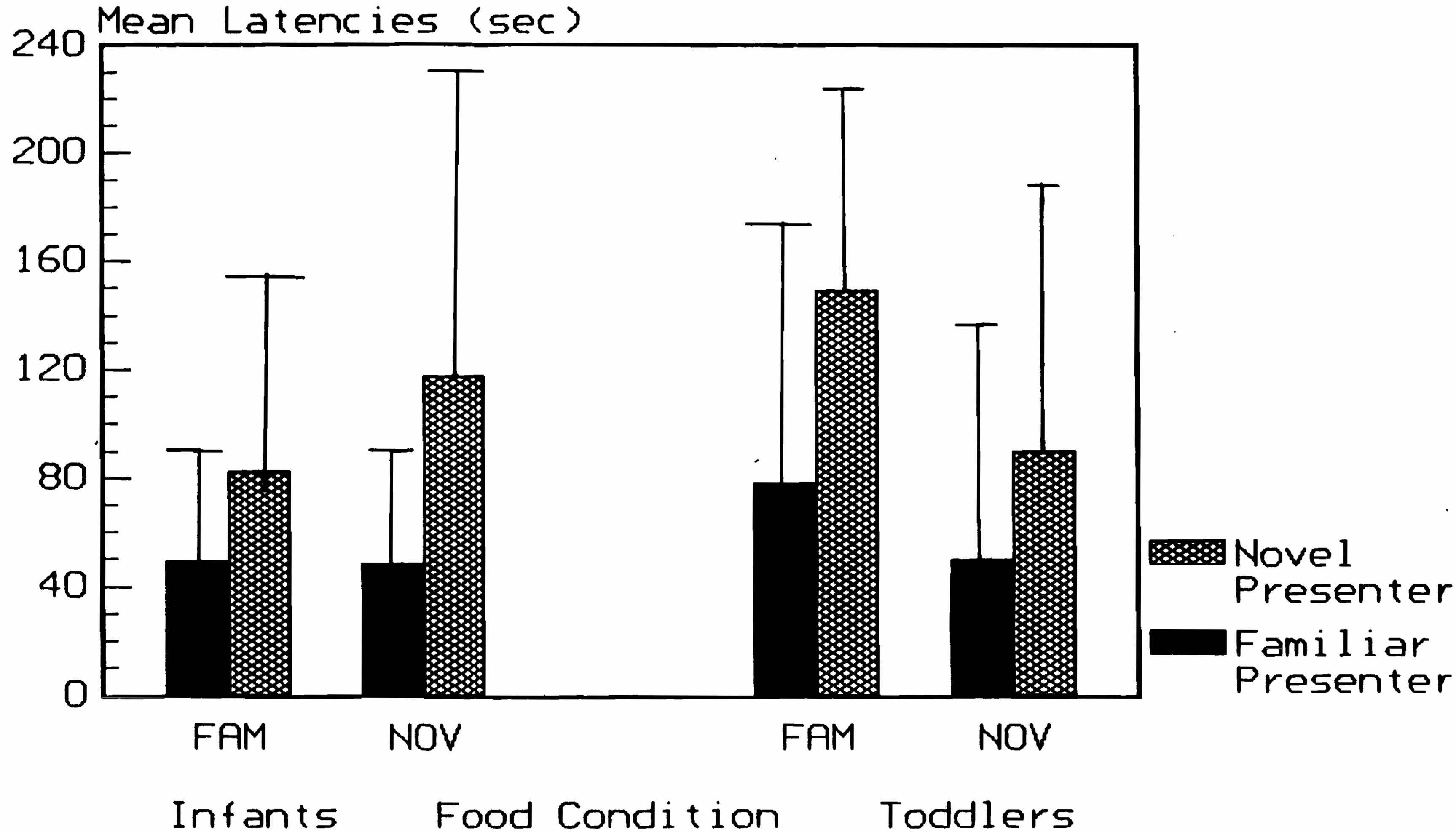

Figure 1

Mean latencies to the second bite for age groups which received a familiar or novel food or presenter.

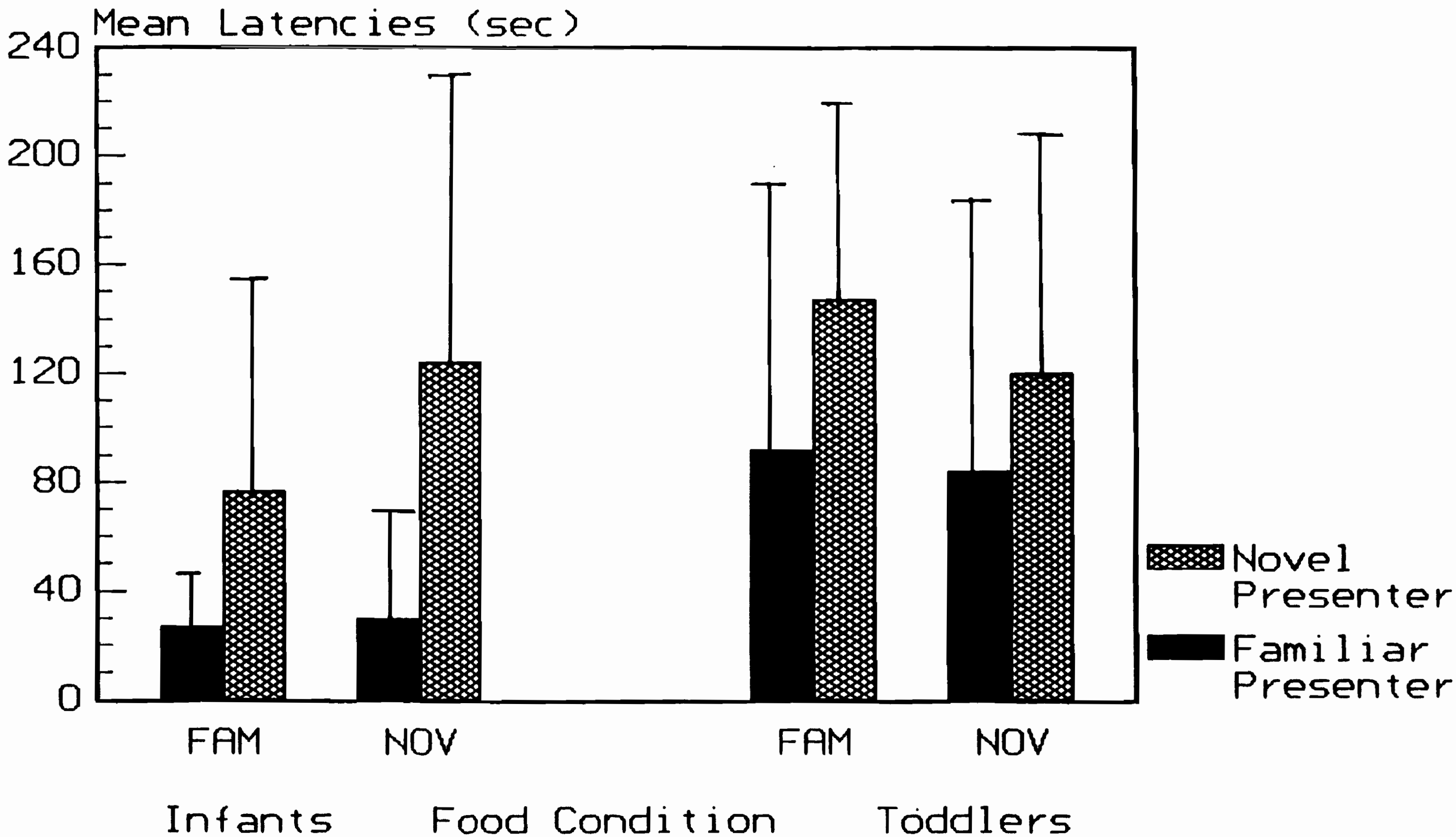

Figure 2

Mean percentage time prior to the second bite that a negative expression* was observed for age groups which received a familiar or novel food.

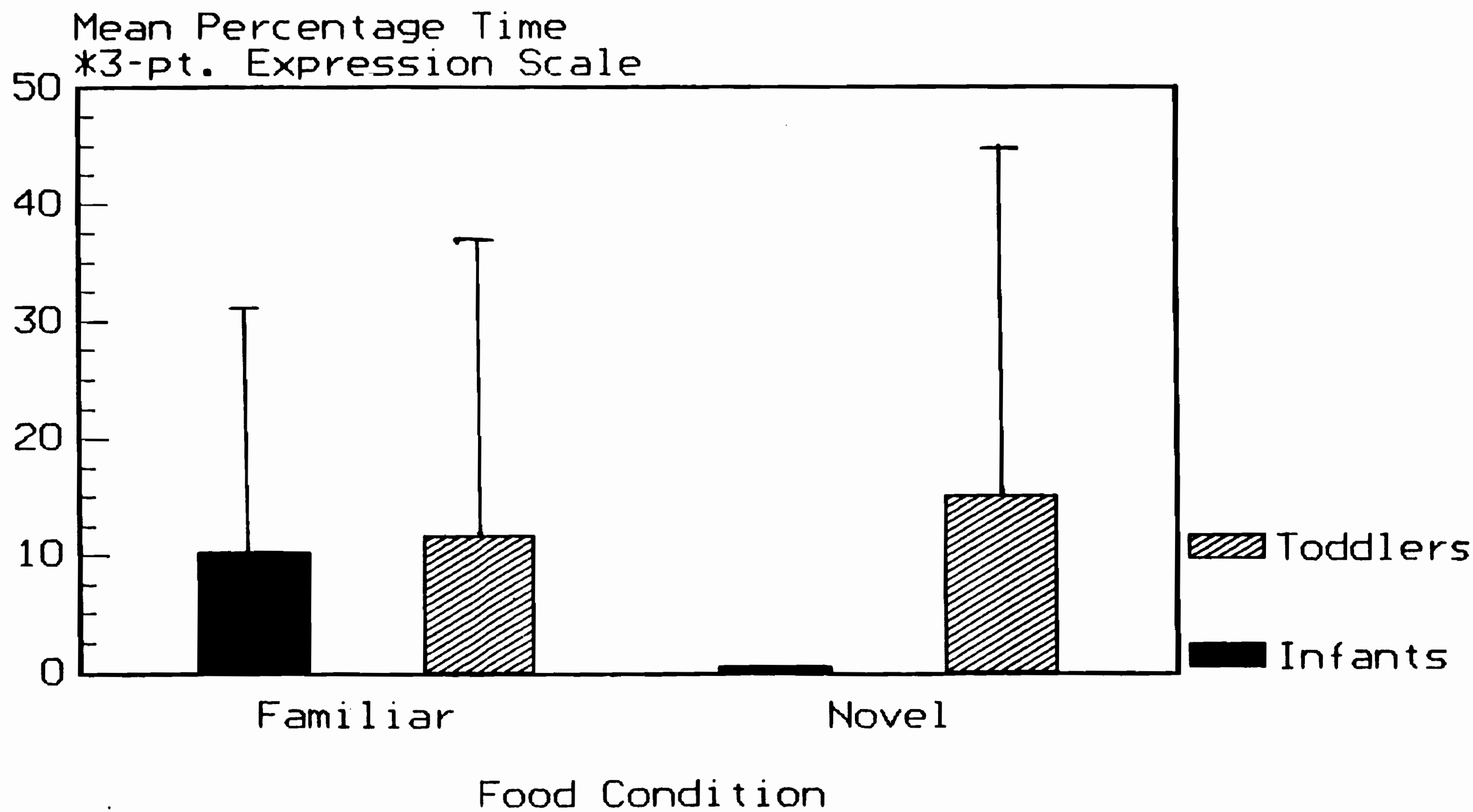

Figure 3

Mean percentage time prior to second bite that a negative expression* (SNEG,VNEG) was observed for age groups which received a familiar or novel food.

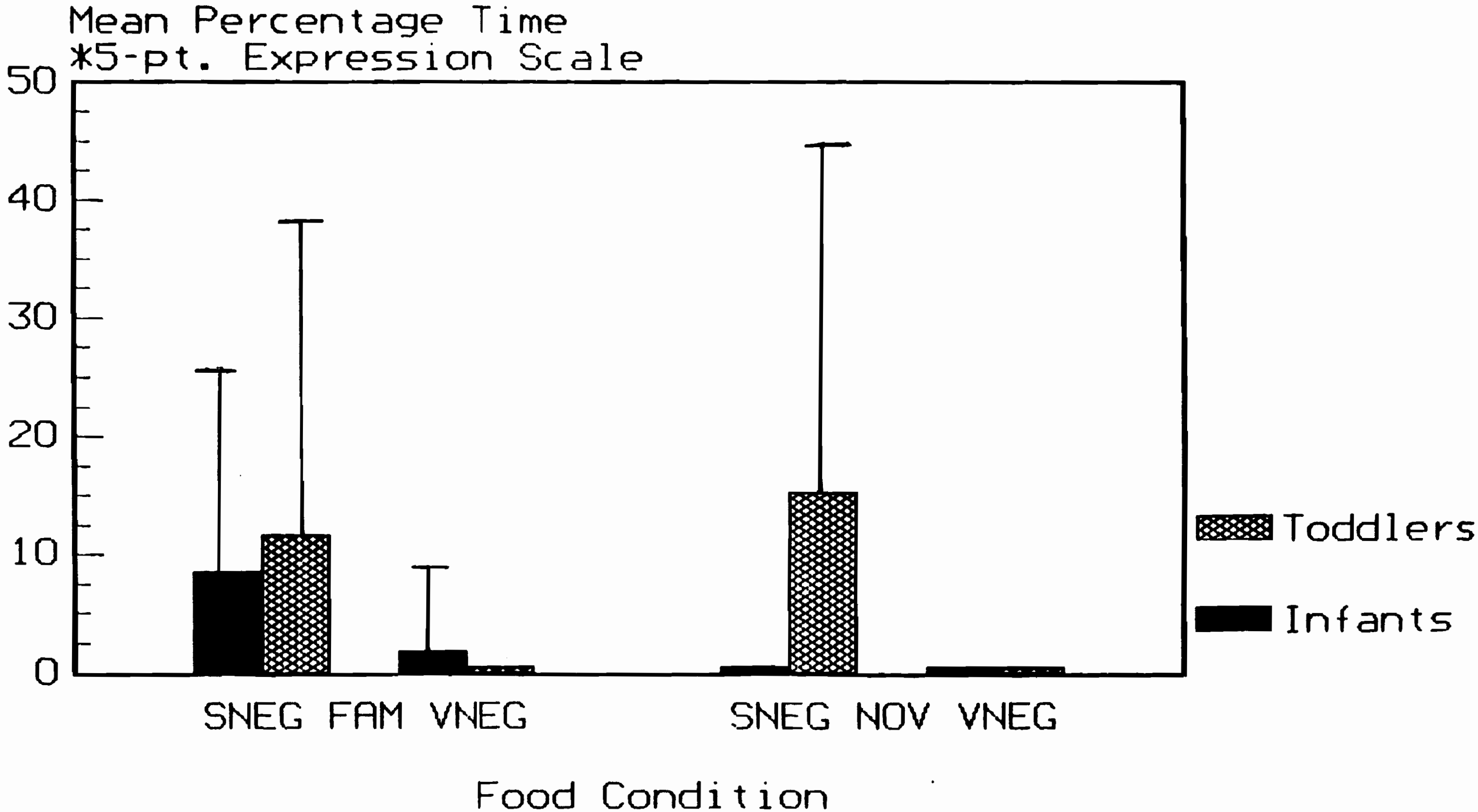

Figure 4

Mean percentage time prior to the first bite that a negative expression* was observed for age groups which received a familiar or novel food.

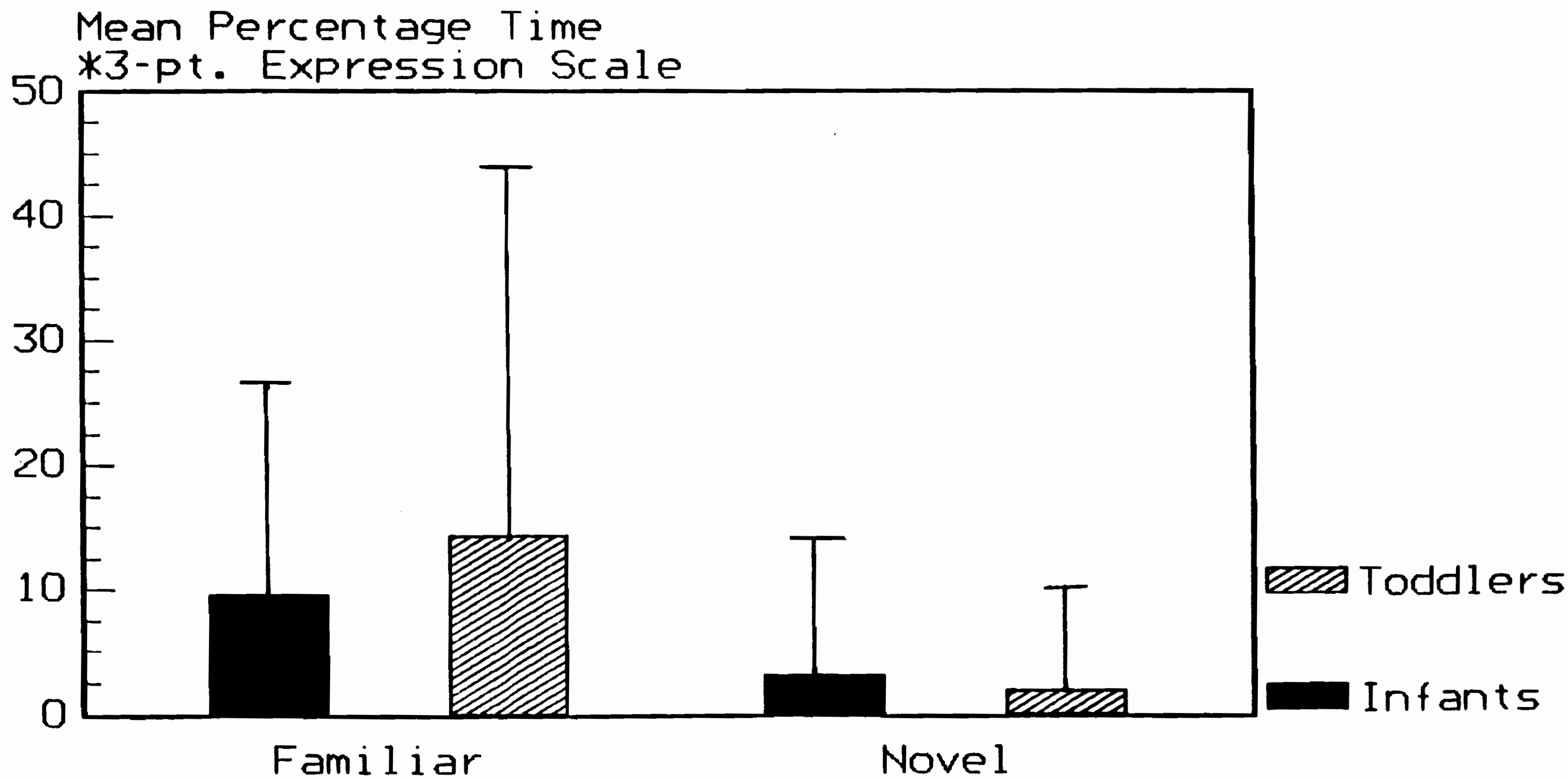

Figure 5

Mean percentage time prior to the first bite that a slightly or very negative expression was observed in age groups which received a familiar or novel food.

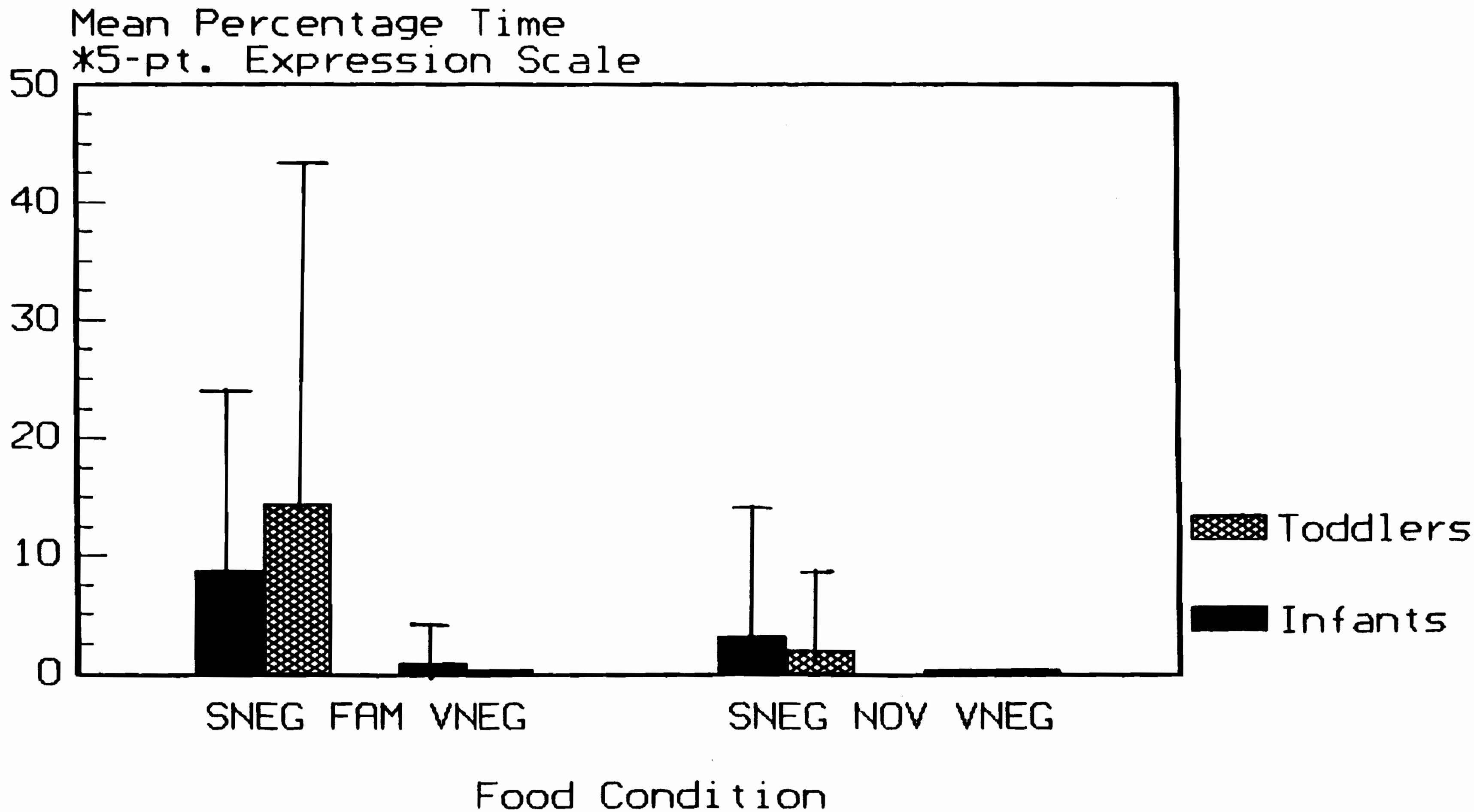

Figure 6

Mean percentage time prior to the first bite that each expression* was observed in infants who received a familiar or novel food or presenter.

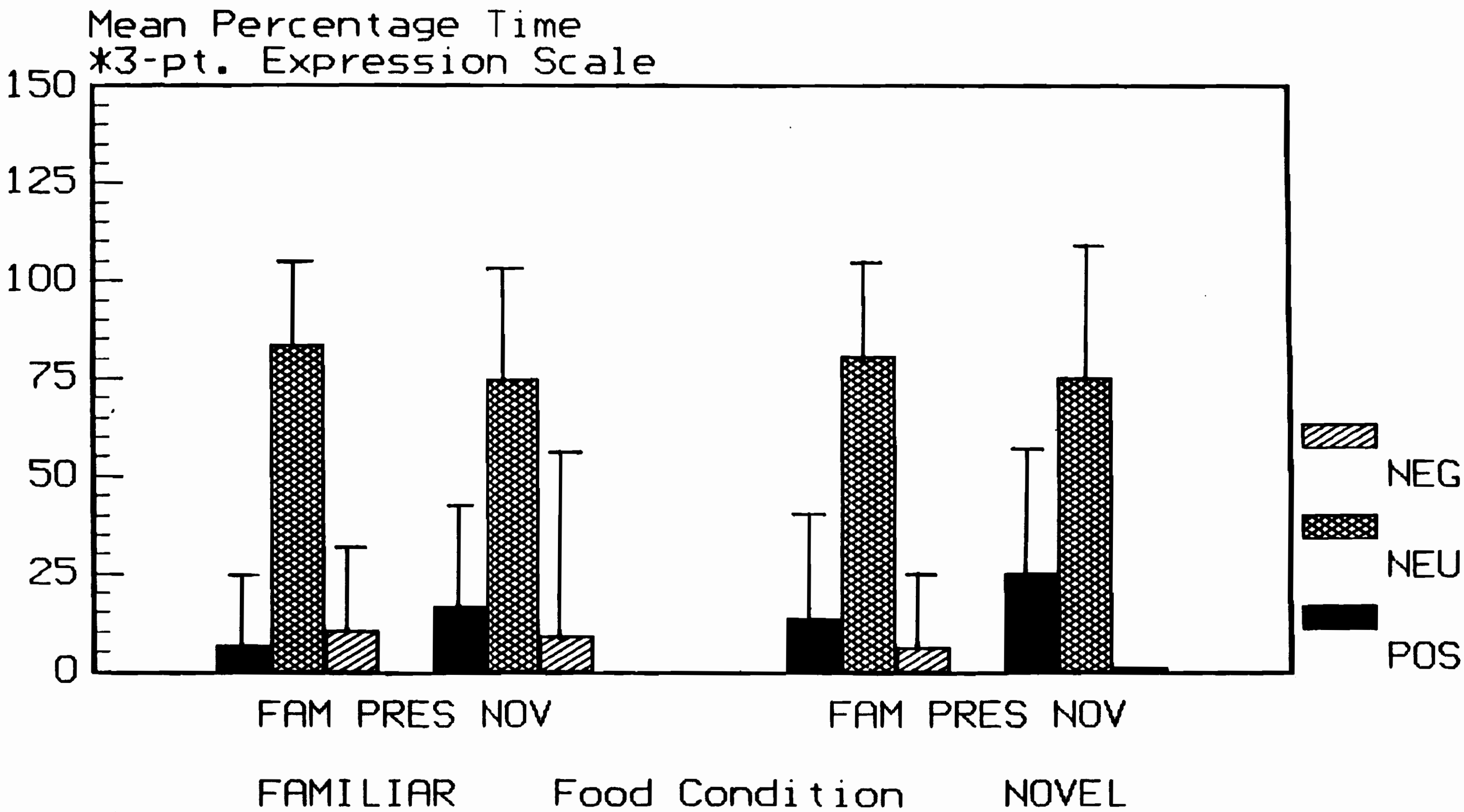

Figure 7

Mean percentage time prior to the first bite that each expression* was observed for infants who received a familiar or novel food or presenter.

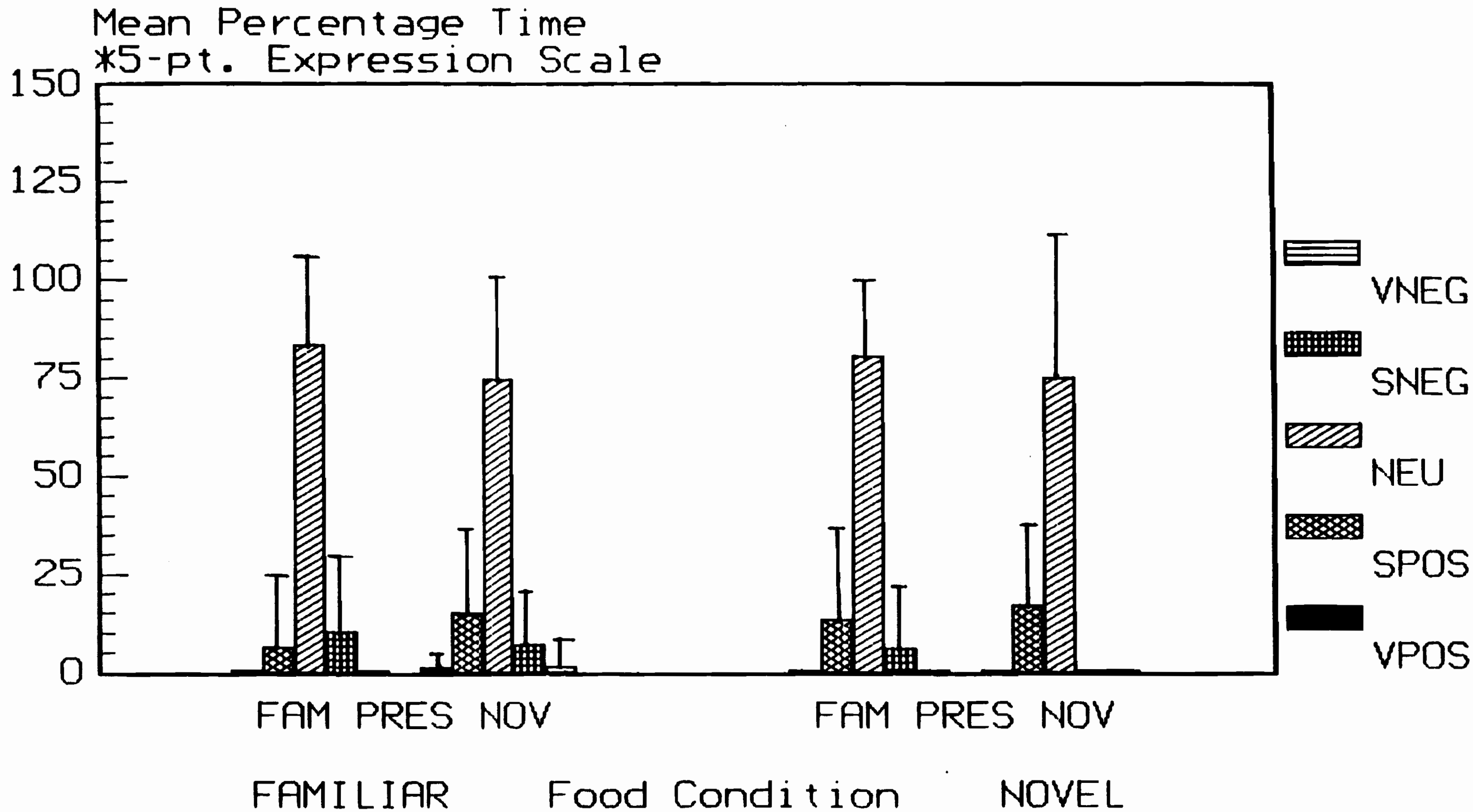

Figure 8

Mean percentage time prior to the first bite that each expression* was observed in toddlers who received a familiar or novel food or presenter.

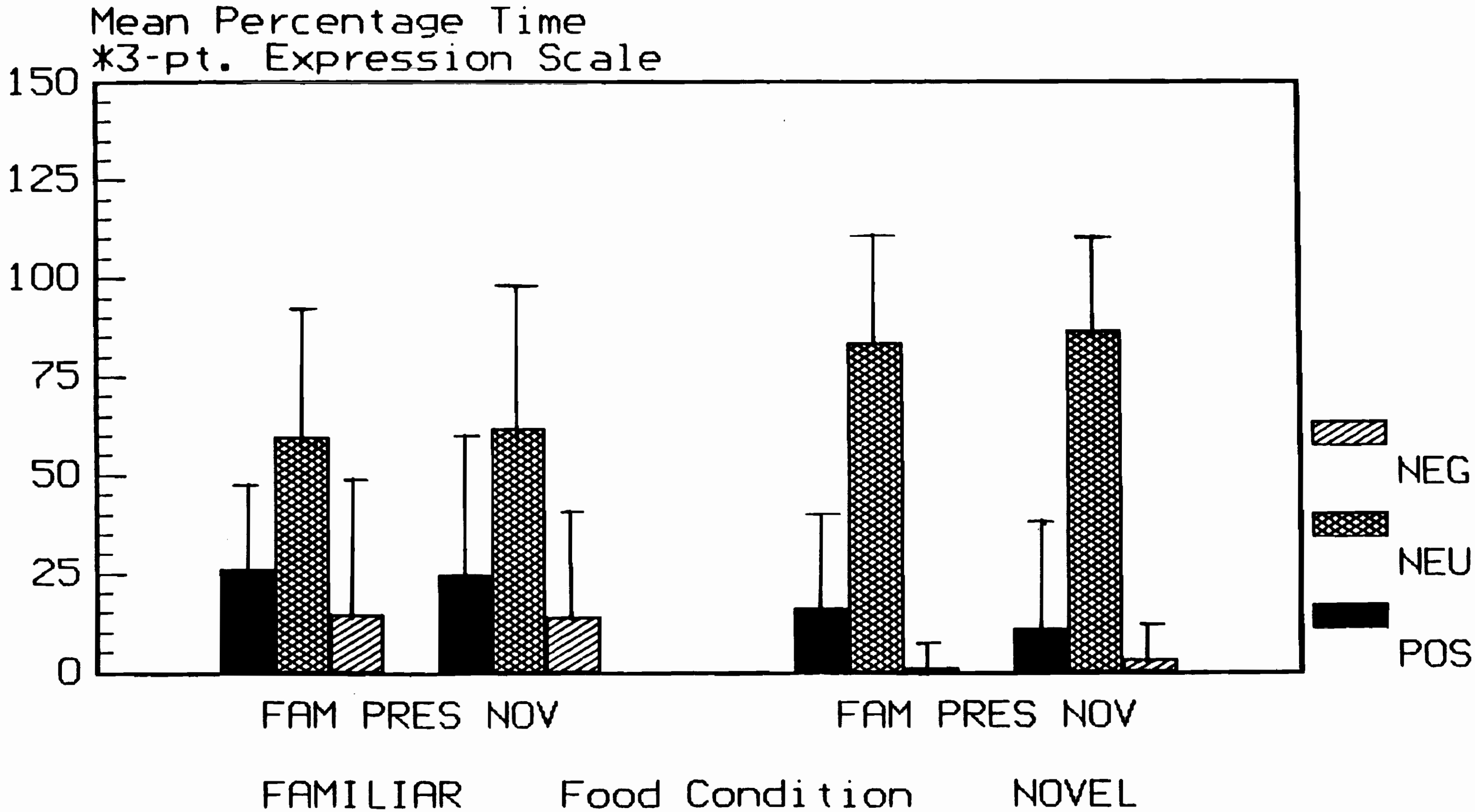

Figure 9

Mean percentage time prior to first bite that each expression* was observed for toddlers who received a familiar or novel food or presenter.

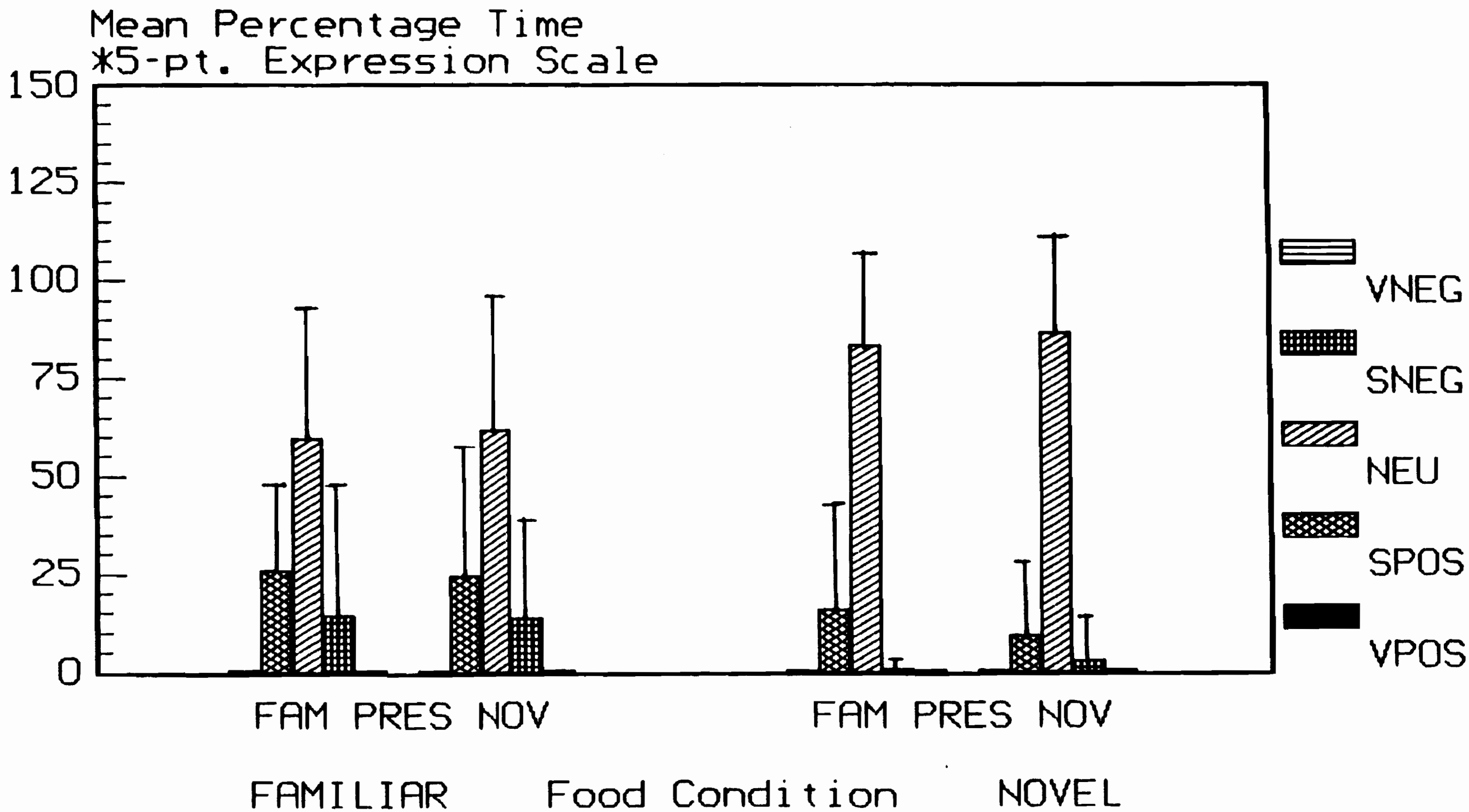

Figure 10

Mean frequencies of upper body flexion prior to the first bite in age groups which received a familiar or novel food or presenter.

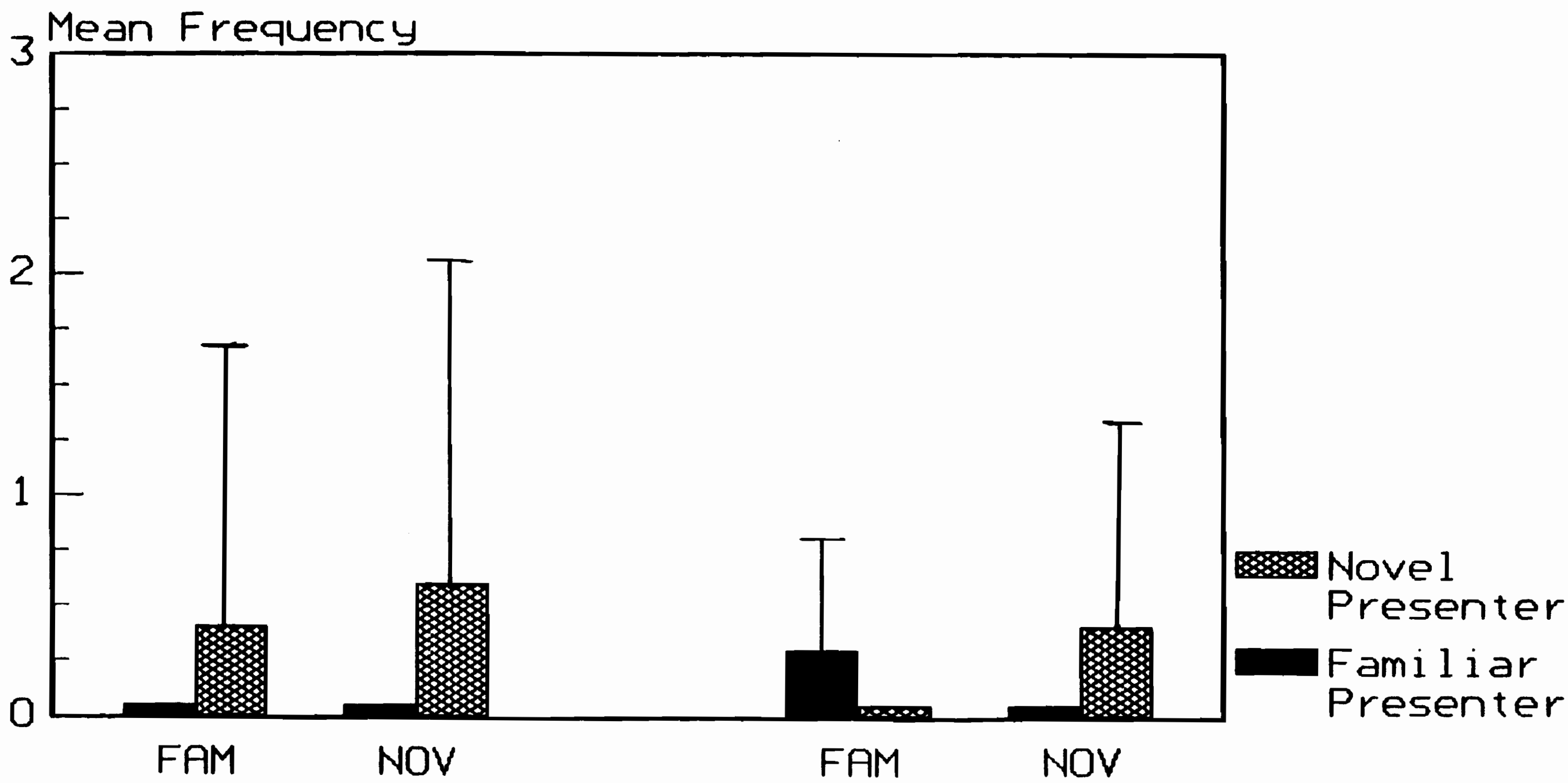

Figure 11

Mean frequencies of pushing away food prior to the first bite in age groups which received a familiar or novel food or presenter.

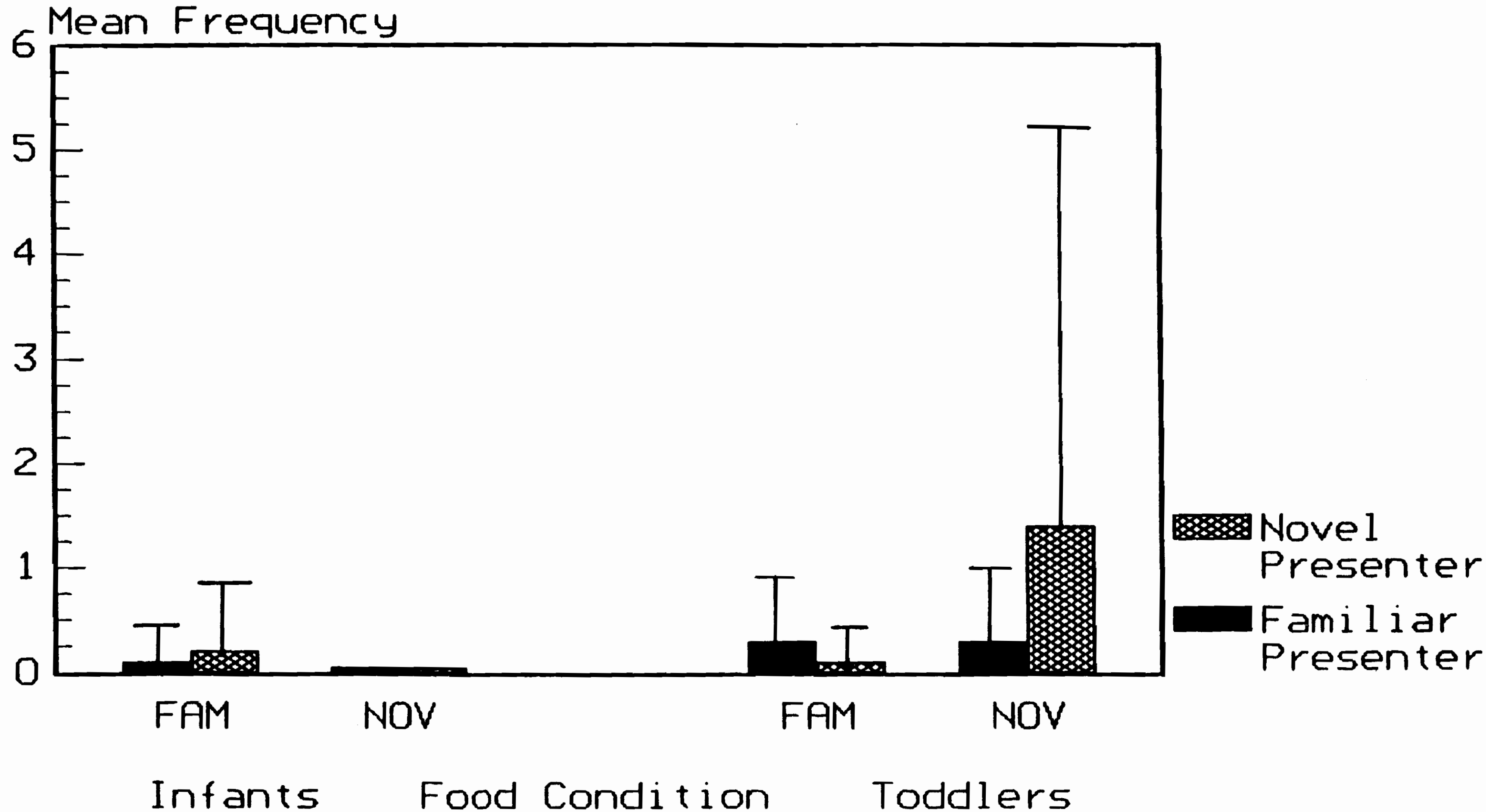

Figure 12

Mean percentage time prior to the second bite that each expression* was observed in infants who received a familiar or novel food or presenter.

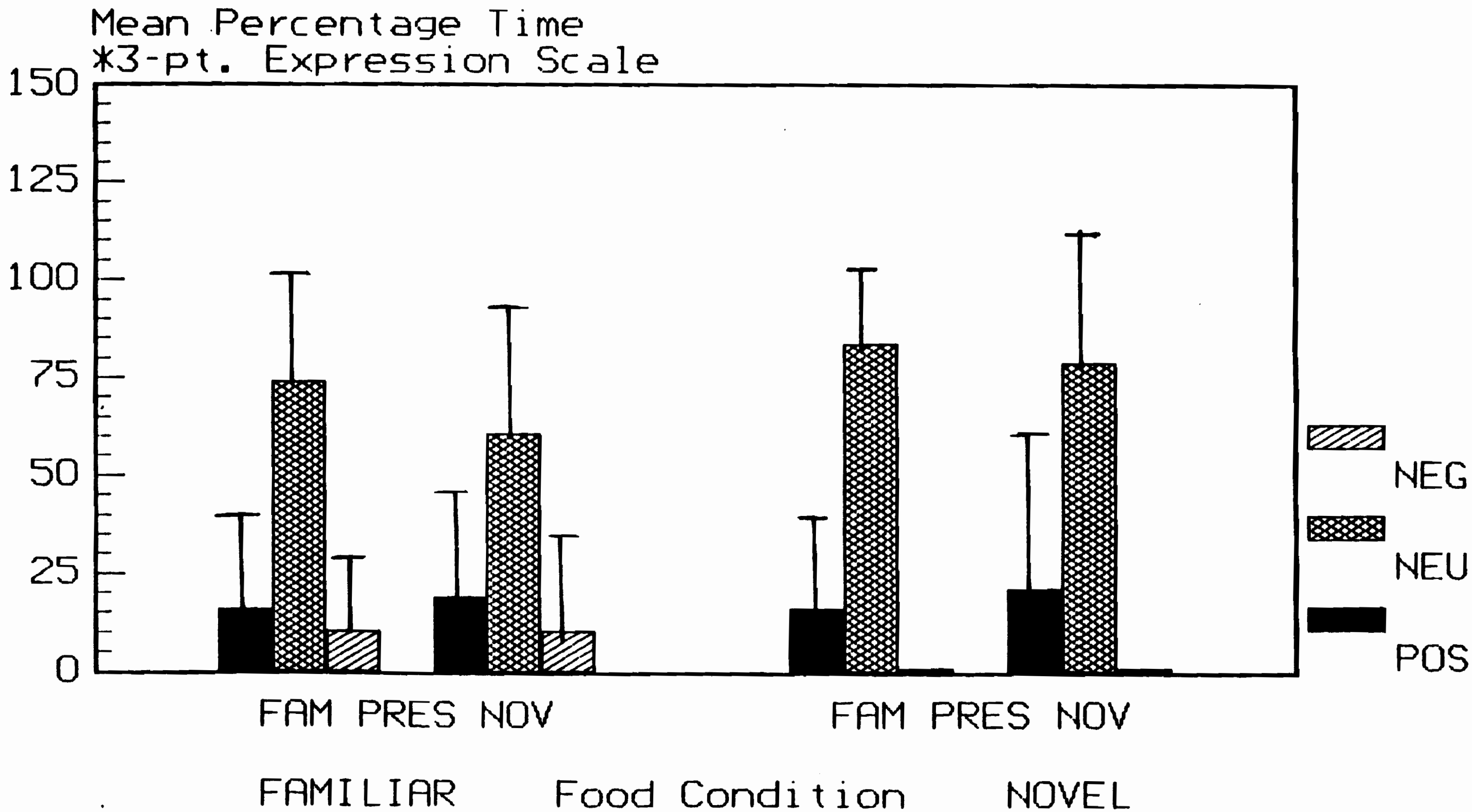

Figure 13

Mean percentage time prior to the second bite that each expression* was observed in infants who received familiar or novel food or presenter.

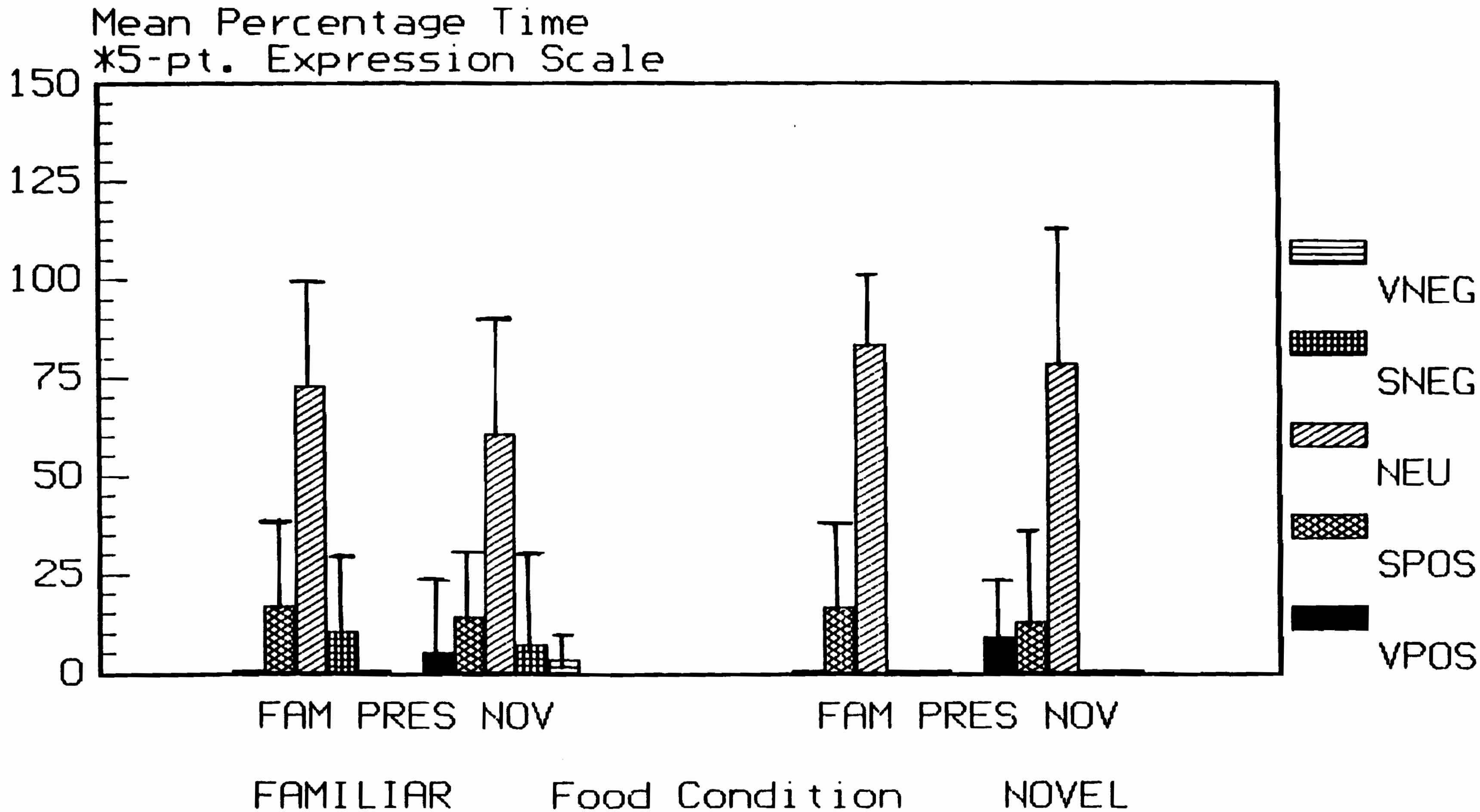

Figure 14

Mean percentage time prior to the second bite that each expression* was observed in toddlers who received a familiar or novel food or presenter.

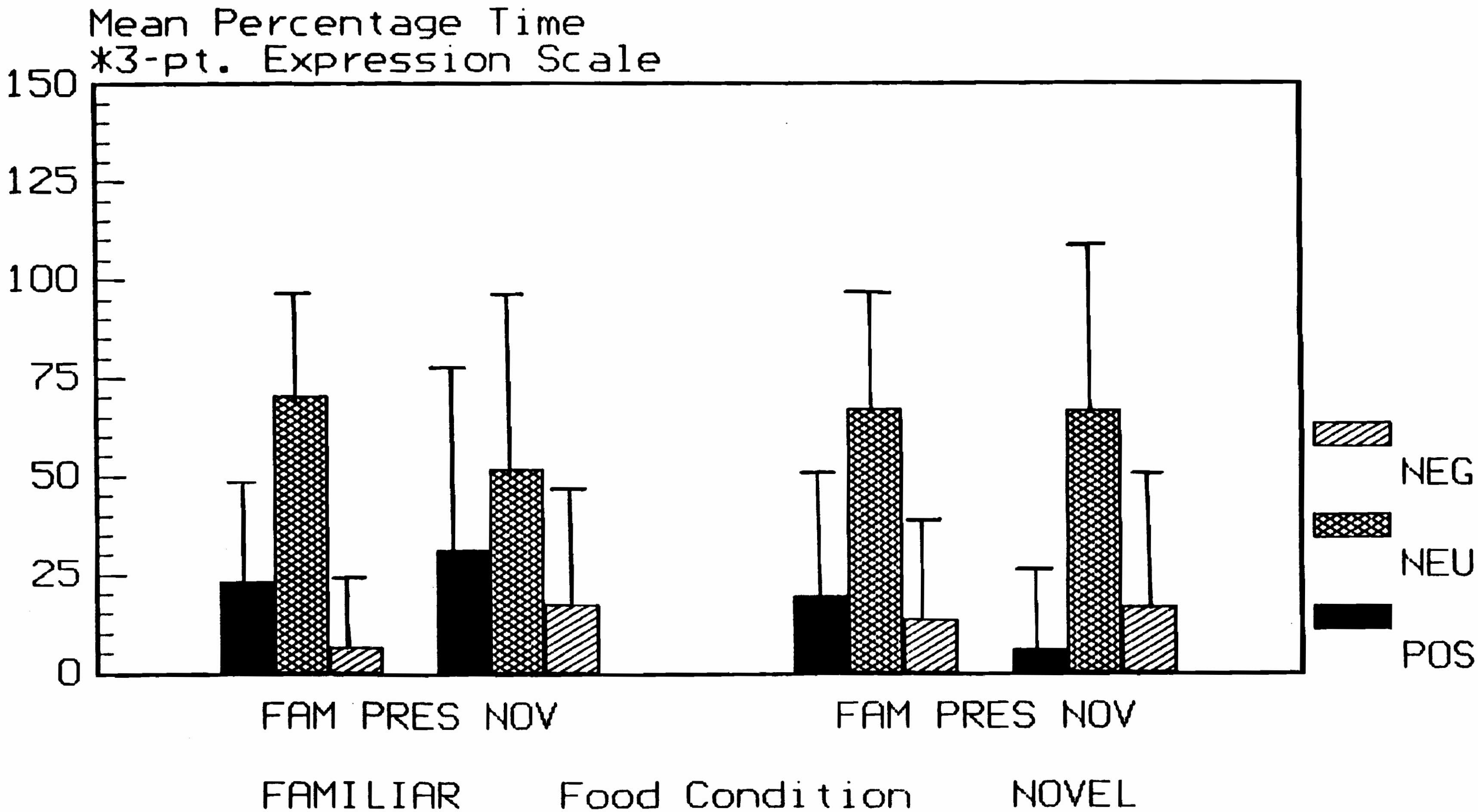

Figure 15

Mean percentage time prior to the second bite that each expression* was observed in toddlers who received a familiar or novel food or presenter.

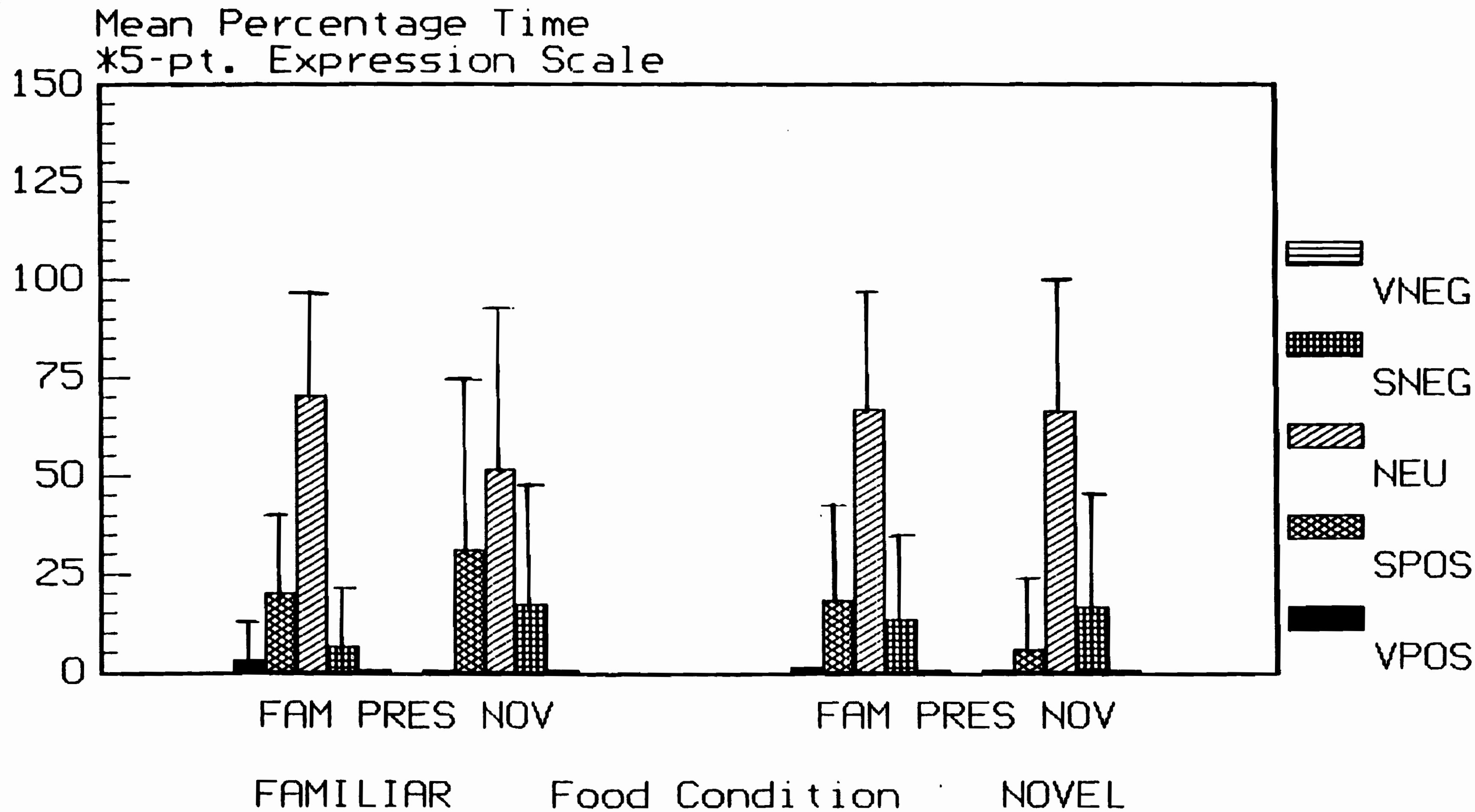

Figure 16

Mean frequencies of upper body flexion prior to the second bite in age groups which received a familiar or novel food or presenter.

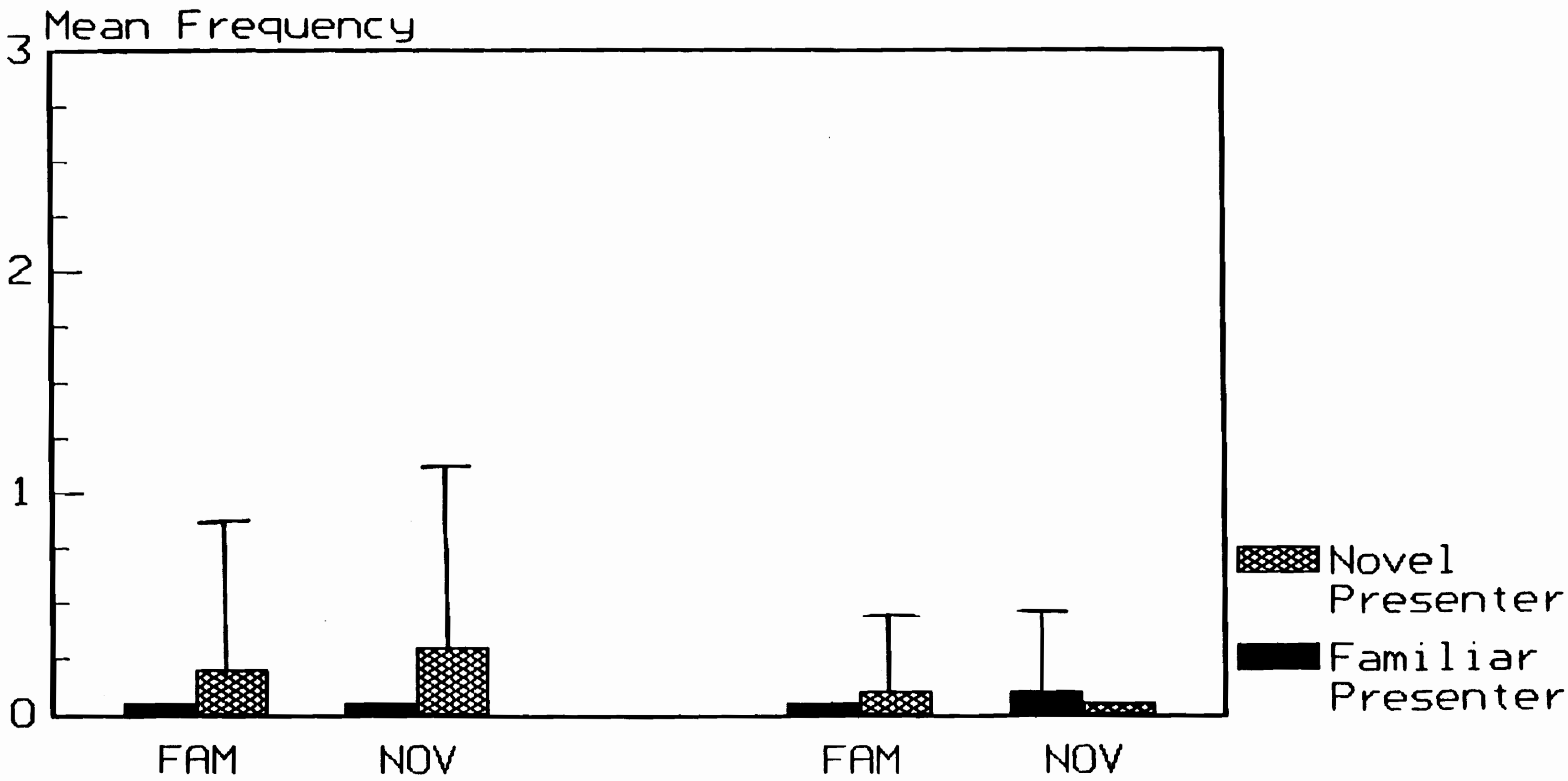

Figure 17

Mean percentage intake scores
for age groups which received a
familiar or novel food or presenter.

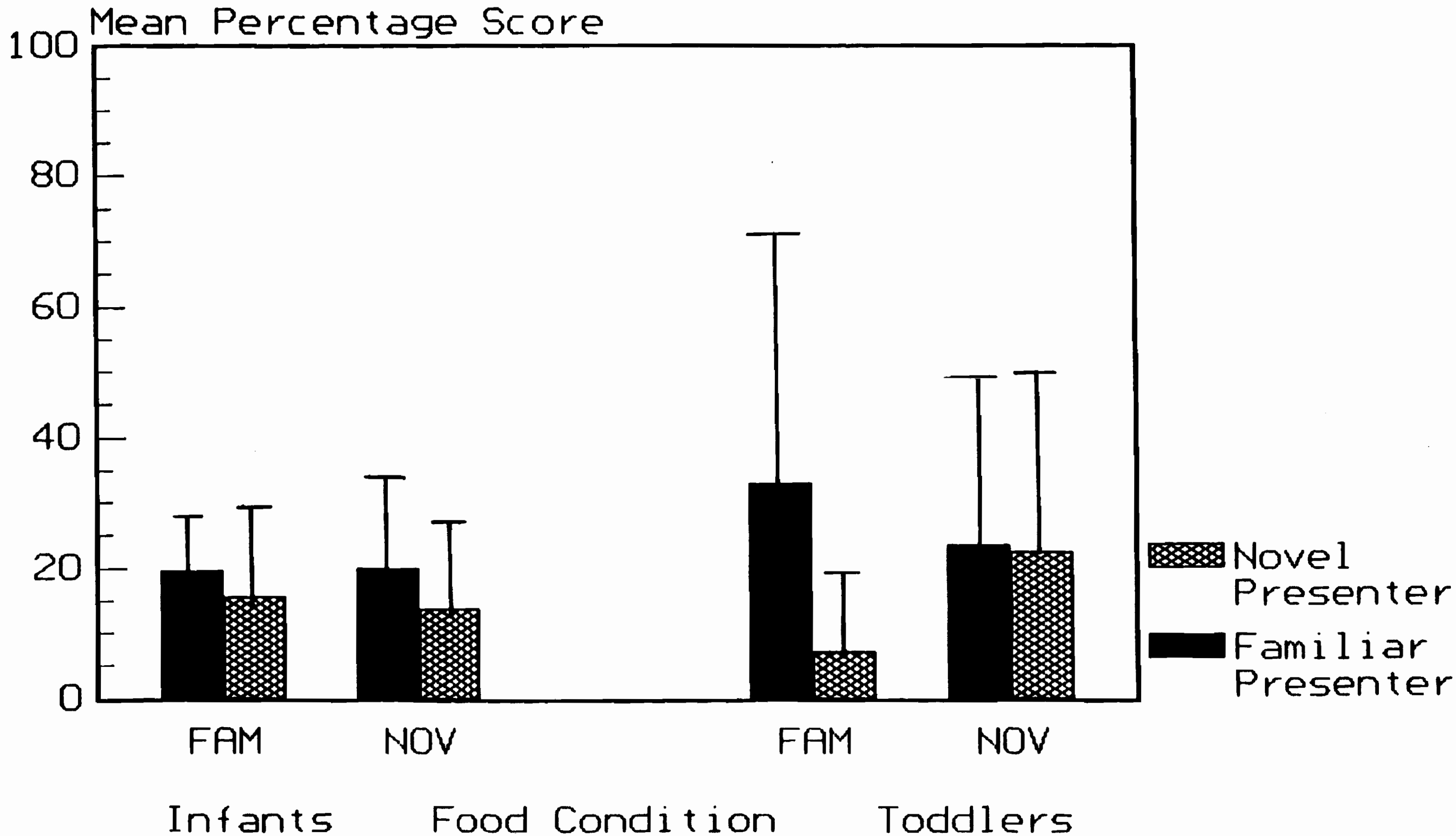

Figure 18

Appendix G

Raw Data

```
DATA LJJDISS;
INPUT CENTER 1-2 GROUP 3 SN 1-5 RATECODE 6 AGE 7
TAT 8 AGETAT 7-8 VIS 9 COND 8-9  EIGHTSET 7-9 FOODCODE 10-11
PRESCODE 12-13 TSTDAT 14-16 PREWTG 17-19 POSTWTG 20-22 AGEMO 4.2
GENDER 27 BREAST 28 BREASTMO 4.2  SOLIDMO 4.2
VARIETY 37-38 ALLERGY 39 HISTALRG 40 TOUCHSEC 41-42
B1 43-45 B2 46-48 SPITB2 49  PUSHB1 50-51
PUSHB2 52-53  FLEXB0 54 FLEXB1 55 FLEXB2 56 RATER 57 @;
IF RATER=1 THEN DO;
INPUT EXPRE1 58-60 EXPRE2 61-63 EXPRE3 64-66 EXPRE4 67-69 RACE 70
#2 EXPRES5 1-3 EXPRE6 4-6 EXPRE7 7-9 EXPRE8 10-12 EXPRE9 13-15
EXB11 16-18 EXB12 19-21 EXB13 22-24 EXB14 25-27 EXB15 28-30
EXB16 31-33 EXB17 34-36 EXB18 37-39 EXB19 40-42 EXB21 43-45
EXB22 46-48 EXB23 49-51 EXB24 52-54 EXB25 55-57 EXB26 58-60
EXB27 61-63 EXB28 64-66 EXB29 67-69 EAT 70;
 /*IF RATECODE GT 1 THEN DELETE;*/
 /*RAWINT=PREWTG-POSTWTG;*/
 /*IF RAWINT>0 THEN AE=LOG10(RAWINT);
ELSE AE=0;*/
 /*LAT0=TOUCHSEC;
LAT1=B1;*/
LAT2=B2-B1;
INT=((PREWTG-POSTWTG)/PREWTG)*100;
 /*IF B1>0 THEN LTB1=LOG10(B1);
ELSE LTB1=0;
IF LAT2>0 THEN LTB2=LOG10(LAT2);
ELSE LTB2=0;*/
 /*IF INT>0 THEN AMOUNT=LOG10(INT);
ELSE AMOUNT=0;*/
 /*IF TOUCHSEC>0 THEN LTB0=LOG10(TOUCHSEC);
ELSE LTB0=0;*/
 /*P1=EXPRE1+EXPRE2;
P2=EXPRE3+EXPRE4;
P3=EXPRE5;
P4=EXPRE6+EXPRE7;
P5=EXPRE8+EXPRE9;*/
 /*PEXP=P1; PTRL=1; OUTPUT;
```



```
PEXP=P2; PTRL=2; OUTPUT;
PEXP=P3; PTRL=3; OUTPUT;
PEXP=P4; PTRL=4; OUTPUT;
PEXP=P5; PTRL=5; OUTPUT;*/
 /*I1=EXB11+EXB12;
I2=EXB13+EXB14;
I3=EXB15;
I4=EXB16+EXB17;
I5=EXB18+EXB19;*/
 /*IEXP=I1; ITRL=1; OUTPUT;
IEXP=I2; ITRL=2; OUTPUT;
```

```
        IEXP=I3; ITRL=3; OUTPUT;
        IEXP=I4; ITRL=4; OUTPUT;
        IEXP=I5; ITRL=5; OUTPUT;*/
         /*C1=EXB21+EXB22;
        C2=EXB23+EXB24;
        C3=EXB25;
        C4=EXB26+EXB27;
        C5=EXB28+EXB29;*/
         /*CEXP=C1; CTRL=1; OUTPUT;
        CEXP=C2; CTRL=2; OUTPUT;
        CEXP=C3; CTRL=3; OUTPUT;
        CEXP=C4; CTRL=4; OUTPUT;
        CEXP=C5; CTRL=5; OUTPUT;*/
         /*IF SPITB2>0 THEN RSP2=SQRT(SPITB2);
        ELSE RSP2=0;
        IF PUSHB1>0 THEN RPU1=SQRT(PUSHB1);
        ELSE RPU1=0;
        IF PUSHB2>0 THEN RPU2=SQRT(PUSHB2);
        ELSE RPU2=0;
        IF FLEXB0>0 THEN RF0=SQRT(FLEXB0);
        ELSE RF0=0;
        IF FLEXB1>0 THEN RF1=SQRT(FLEXB1);
        ELSE RF1=0;
        IF FLEXB2>0 THEN RF2=SQRT(FLEXB2);
        ELSE RF2=0;*/
         /*POS=EXPRE1+EXPRE2+EXPRE3+EXPRE4;
        NEU=EXPRE5;
        NEG=EXPRE6+EXPRE7+EXPRE8+EXPRE9;*/
         /*POSB1=EXB11+EXB12+EXB13+EXB14;
        NEUB1=EXB15;
        NEGB1=EXB16+EXB17+EXB18+EXB19;*/
         /*POSB2=EXB21+EXB22+EXB23+EXB24;
        NEUB2=EXB25;
        NEGB2=EXB26+EXB27+EXB28+EXB29;*/
         /*PEXP=POS; PTRL=1; OUTPUT;
        PEXP=NEU; PTRL=2; OUTPUT;
        PEXP=NEG; PTRL=3; OUTPUT;*/
         /*IEXP=POSB1; ITRL=1; OUTPUT;
        IEXP=NEUB1; ITRL=2; OUTPUT;
        IEXP=NEGB1; ITRL=3; OUTPUT;*/
         /*CEXP=POSB2; CTRL=1; OUTPUT;
        CEXP=NEUB2; CTRL=2; OUTPUT;
        CEXP=NEGB2; CTRL=3; OUTPUT;*/
         /*SLINEG1=I4;
        SLINEG2=C4;*/
        OUTPUT;
        END;
```

```
IF RATER=0 THEN DO;
INPUT EXPRE9 58-60 EXPRE8 61-63 EXPRE7 64-66 EXPRE6 67-69 RACE 70
#2 EXPRE5 1-3 EXPRE4 4-6 EXPRE3 7-9 EXPRE2 10-12 EXPRE1 13-15
EXB19 16-18 EXB18 19-21 EXB17 22-24 EXB16 25-27 EXB15 28-30
EXB14 31-33 EXB13 34-36 EXB12 37-39 EXB11 40-42 EXB29 43-45
EXB28 46-48 EXB27 49-51 EXB26 52-54 EXB25 55-57 EXB24 58-60
EXB23 61-63 EXB22 64-66 EXB21 67-69 EAT 70;
 /*IF RATECODE GT 1 THEN DELETE;
LAT0=TOUCHSEC;
LAT1=B1;*/
LAT2=B2-B1;
 /*RAWINT=PREWTG-POSTWTG;*/
INT=((PREWTG-POSTWTG)/PREWTG)*100;
 /*IF B1>0 THEN LTB1=LOG10(B1);
ELSE LTB1=0;
IF LAT2>0 THEN LTB2=LOG10(LAT2);
ELSE LTB2=0;*/
 /*IF INT>0 THEN AMOUNT=LOG10(INT);
ELSE AMOUNT=0;*/
 /*IF TOUCHSEC>0 THEN LTB0=LOG10(TOUCHSEC);
ELSE LTB0=0;*/
 /*IF RAWINT>0 THEN AE=LOG10(RAWINT);
ELSE AE=0;*/
 /*P5=EXPRE9+EXPRE8;
P4=EXPRE7+EXPRE6;
P3=EXPRE5;
P2=EXPRE4+EXPRE3;
P1=EXPRE2+EXPRE1;*/
 /*PEXP=P5; PTRL=5; OUTPUT;
PEXP=P4; PTRL=4; OUTPUT;
PEXP=P3; PTRL=3; OUTPUT;
PEXP=P2; PTRL=2; OUTPUT;
PEXP=P1; PTRL=1; OUTPUT;*/
 /*I5=EXB19+EXB18;
I4=EXB17+EXB16;
I3=EXB15;
I2=EXB14+EXB13;
I1=EXB21+EXB11;*/
 /*IEXP=I5; ITRL=5; OUTPUT;
IEXP=I4; ITRL=4; OUTPUT;
IEXP=I3; ITRL=3; OUTPUT;
IEXP=I2; ITRL=2; OUTPUT;
IEXP=I1; ITRL=1; OUTPUT;*/
 /*C5=EXB29+EXB28;
C4=EXB27+EXB26;
C3=EXB25;
C2=EXB24+EXB23;
C1=EXB22+EXB21;*/
 /*CEXP=C5; CTRL=5; OUTPUT;
CEXP=C4; CTRL=4; OUTPUT;
```

```
CEXP=C3; CTRL=3; OUTPUT;
CEXP=C2; CTRL=2; OUTPUT;
CEXP=C1; CTRL=1; OUTPUT;*/
 /*IF SPITB2>0 THEN RSP2=SQRT(SPITB2);
ELSE RSP2=0;
IF PUSHB1>0 THEN RPU1=SQRT(PUSHB1);
ELSE RPU1=0;
IF PUSHB2>0 THEN RPU2=SQRT(PUSHB2);
```



```
ELSE RPU2=0;
IF FLEXB0>0 THEN RF0=SQRT(FLEXB0);
ELSE RF0=0;
IF FLEXB1>0 THEN RF1=SQRT(FLEXB1);
ELSE RF1=0;
IF FLEXB2>0 THEN RF2=SQRT(FLEXB2);
ELSE RF2=0;*/
 /*NEG=EXPRE9+EXPRE8+EXPRE7+EXPRE6;
NEU=EXPRE5;
POS=EXPRE4+EXPRE3+EXPRE2+EXPRE1;*/
 /*NEGB1=EXB19+EXB18+EXB17+EXB16;
NEUB1=EXB15;
POSB1=EXB14+EXB13+EXB12+EXB11;*/
 /*NEGB2=EXB29+EXB28+EXB27+EXB26;
NEUB2=EXB25;
POSB2=EXB24+EXB23+EXB22+EXB21;*/
 /*PEXP=NEG; PTRL=3; OUTPUT;
PEXP=NEU; PTRL=2; OUTPUT;
PEXP=POS; PTRL=1; OUTPUT;*/
 /*IEXP=NEGB1; ITRL=3; OUTPUT;
IEXP=NEUB1; ITRL=2; OUTPUT;
IEXP=POSB1; ITRL=1; OUTPUT;*/
 /*CEXP=NEGB2; CTRL=3; OUTPUT;
CEXP=NEUB2; CTRL=2; OUTPUT;
CEXP=POSB2; CTRL=1; OUTPUT;*/
 /*SLINEG1=I4;
SLINEG2=C4;*/
OUTPUT;
END;
CARDS;
```

NOTE: The data set WORK.LJJDISS has 80 observations and 64 variables.

```
PROC PRINT;
 /*NOTE CENTER NAMES 01=SHAWVALLE, 02=MT.TABOR, 03=ROANOKE MEMORIAL,
04=DOMINION/CORPORATE, 06=DOWNTOWN L.C., 07=CALVARY BAPTIST, 08=CHURCH
COURT, 09=SONSHINE, 10=HUGS N MORE, 11=HONEY TREE-LG, 12=HT460,
13=HTMCVITTY, 14=HTVA SALEM*/
 /*NOTE FOOD CODES 01=SWEET POTATO, 02=YELLOW SQUASH, 03=APRICOT JELLO,
04=RED JELLO W/APRICOT NECTAR, 05=WHITE POTATO, 06=ZUCCHINI,
```

```
07=BUTTERNUT SQUASH, 08=RED JELLO PLAIN, 09=RITZ, 10=GINGER SNAPS
11=*/
 /*NOTE PRESENTER CODE 00=FAMILIAR, 01=PAM SCHUETZE, 02=MARTY BROWN,
03=JANE ABRAHAM, 04=KARYN CARR, 05=BETH SOEKEN, 06=LAURA HOUGH*/
 /*NOTE FAMILIAR=0 NOVEL=1*/
 /*NOTE MALE=0,FEMALE=1*/
 /*NOTE NO=0, YES=1*/
 /*NOTE RATER DAVE A=0, ROB B=1*/
 /*NOTE INTERRATER CODE COL 6 MEANS ONLY 1 RATING=0 1=COUNTED 2=EXTRA*/
 /*NOTE EAT CODE IS 0=DID NOT EAT, 1=ATE*/
 /*NOTE RACE CODE IS 0=NONWHITE 1=WHITE*/
```


OBS	CENTER	GROUP	SN	RATECODE	AGE	TAT	AGETAT	VIS	COND	EIGHTSET	FOODCODE	PRESCODE	TSTDAT	PREWTG	POSTWTG	AGEMO	GENDER	BREAST	BREASTMO	SOLIDMO	VARIETY	ALLERGY	HISTALRG	TOUCHSEC	B1	B2	SPITB2	PUSHB1	PUSHB2	FLEXB0	FLEXB1	FLEXB2
1	1	0	1001	0	0	0	0	1	1	1	1	5	430	87	65	9.00	0	0	0.00	6.00	15	0	0	4	21	35	0	0	1	0	0	0
2	1	0	1002	0	0	0	0	0	0	0	4	0	430	118	100	9.00	0	0	0.00	0.00	16	0	0	3	93	118	0	0	0	0	0	0
3	1	1	1101	0	1	1	11	0	10	110	3	0	430	120	64	17.50	1	1	2.00	4.00	35	0	0	33	86	103	0	0	0	0	0	0
4	2	0	2001	1	0	0	0	1	1	1	9	1	520	23	22	12.00	1	0	0.00	5.00	24	1	1	11	39	69	0	0	0	0	0	0
5	2	0	2001	2	0	0	0	1	1	1	9	1	520	23	22	12.00	1	0	0.00	5.00	24	1	1	11	45	72	0	0	1	0	0	0
6	2	1	2101	2	1	0	10	1	1	101	7	1	520	99	99	17.00	0	1	6.00	5.00	36	0	0	0	240	480	0	0	0	0	0	0
7	2	1	2101	1	1	0	10	1	1	101	7	1	520	99	99	17.00	0	1	6.00	5.00	36	0	0	0	240	480	0	1	0	0	0	0
8	2	1	2103	1	1	1	11	0	10	110	7	0	520	86	80	19.00	0	1	10.00	6.00	42	0	0	5	7	247	1	0	0	0	0	0
9	2	1	2103	2	1	1	11	0	10	110	7	0	520	86	80	19.00	0	1	10.00	6.00	42	0	0	4	9	249	1	0	1	0	0	1
10	3	0	3002	0	0	1	1	0	10	10	2	0	514	80	62	9.00	0	1	2.00	6.00	23	0	0	5	11	24	0	0	0	0	0	0
11	3	1	3101	1	1	0	10	0	0	100	1	0	514	76	67	20.00	1	0	0.00	3.00	47	0	0	3	6	33	0	0	1	0	0	0
12	3	1	3101	2	1	0	10	0	0	100	1	0	514	76	67	20.00	1	0	0.00	3.00	47	0	0	4	5	34	0	0	0	0	0	0
13	3	1	3102	1	1	1	11	1	11	111	2	4	514	73	73	15.00	1	1	2.00	4.00	34	0	0	36	240	480	0	1	0	0	0	0
14	3	1	3102	2	1	1	11	1	11	111	2	4	514	73	73	15.00	1	1	2.00	4.00	34	0	0	36	240	480	0	1	1	0	0	0
15	3	1	3103	1	1	1	11	0	10	110	2	0	514	74	70	16.00	0	1	1.25	4.00	40	0	0	1	2	18	0	0	0	0	0	0
16	3	1	3103	2	1	1	11	0	10	110	2	0	514	74	70	16.00	0	1	1.25	4.00	40	0	0	1	4	19	0	0	0	0	0	0
17	3	1	3104	1	1	0	10	1	1	101	5	2	522	62	60	14.02	1	1	14.50	8.00	41	0	0	2	120	233	0	0	1	0	0	0
18	3	1	3104	2	1	0	10	1	1	101	5	2	522	62	60	14.02	1	1	14.50	8.00	41	0	0	2	120	238	0	13	11	0	0	1
19	3	1	3105	2	1	0	10	0	0	100	5	0	522	70	10	15.00	0	0	10.00	6.00	29	0	0	2	5	15	0	0	0	0	0	0

OBS	RATER	EXPRE1	EXPRE2	EXPRE3	EXPRE4	RACE	EXPRE5	EXPRE6	EXPRE7	EXPRE8	EXPRE9	EXB11	EXB12	EXB13	EXB14	EXB15	EXB16	EXB17	EXB18	EXB19	EXB21	EXB22	EXB23	EXB24	EXB25	EXB26	EXB27	EXB28	EXB29	EAT	LAT2	INT

1	0	0	0	0	0	1	100	0	0	0	0	0	0	0	25	50	25	0	0	0	0	0	0	0	100	0	0	0	0	1	14	25.287
2	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	25	15.254
3	0	0	0	0	50	1	50	0	0	0	0	0	0	0	50	50	0	0	0	0	0	0	0	0	100	0	0	0	0	1	17	46.667
4	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	30	4.348
5	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	27	4.348
6	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	240	0.000
7	1	0	0	0	100	1	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	240	0.000
8	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	11	45	33	11	0	0	1	240	6.977
9	1	0	0	0	100	1	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	4	26	31	22	13	4	0	1	240	6.977
10	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	13	22.500
11	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	33	67	0	0	0	0	1	27	11.842
12	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	29	11.842
13	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	240	0.000
14	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	240	0.000
15	0	0	0	0	0	1	50	50	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	16	5.405
16	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	15	5.405
17	0	0	0	0	0	1	100	0	0	0	0	0	0	0	25	50	25	0	0	0	0	0	0	0	20	60	20	0	0	1	113	3.226
18	1	0	0	0	0	1	100	0	0	0	0	0	0	0	17	67	16	0	0	0	0	0	0	0	50	37	13	0	0	1	118	3.226
19	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	67	33	0	0	0	1	10	85.714

OBS	CENTER	GROUP	SN	RATECODE	AGE	TAT	AGETAT	VIS	COND	EIGHTSET	FOODCODE	PRESCODE	TSTDAT	PREWTG	POSTWTG	AGEMO	GENDER	BREAST	BREASTMO	SOLIDMO	VARIETY	ALLERGY	HISTALRG	TOUCHSEC	B1	B2	SPITB2	PUSHB1	PUSHB2	FLEXB0	FLEXB1	FLEXB2
20	3	1	3105	1	1	0	10	0	0	100	5	0	522	70	10	15.0	0	0	10.00	6.00	29	0	0	1	5	14	0	0	0	0	0	0
21	3	1	3106	0	1	1	11	1	11	111	3	0	505	118	4	18.0	1	1	10.00	6.00	30	0	0	0	120	240	0	0	0	0	0	0
22	3	1	3107	1	1	1	11	0	10	110	7	0	505	84	84	21.0	1	1	1.75	8.00	44	1	1	0	240	480	0	2	0	0	0	1
23	3	1	3107	2	1	1	11	0	10	110	7	0	505	84	84	21.0	1	1	1.75	8.00	44	1	1	0	240	480	0	3	0	0	3	0
24	3	1	3108	0	1	0	10	1	1	101	7	0	505	73	69	22.0	1	1	2.00	4.00	28	0	0	0	120	240	0	0	0	0	0	0
25	3	1	3109	2	1	0	10	0	0	100	5	0	505	70	50	21.0	0	1	15.00	6.00	16	1	1	2	5	14	0	0	0	0	0	0
26	3	1	3109	1	1	0	10	0	0	100	5	0	505	70	50	21.0	0	1	15.00	6.00	16	1	1	2	6	17	0	0	0	0	0	0
27	3	1	3110	1	1	1	11	1	11	111	2	0	514	90	63	17.0	0	1	4.00	4.00	25	0	0	15	51	107	0	0	0	0	0	0
28	3	1	3110	2	1	1	11	1	11	111	2	0	514	90	63	17.0	0	1	4.00	4.00	25	0	0	16	36	108	0	0	0	0	0	0
29	4	0	4001	1	0	1	1	1	11	11	11	6	428	116	116	10.5	1	0	0.00	9.00	25	0	0	35	240	480	0	0	0	0	0	0
30	4	0	4001	2	0	1	1	1	11	11	11	6	428	116	116	10.5	1	0	0.00	9.00	25	0	0	34	240	480	0	0	1	3	0	0
31	4	0	4003	0	0	0	0	1	1	1	5	0	501	75	70	12.0	1	1	10.50	8.00	42	0	0	66	73	193	0	0	0	0	0	0
32	4	0	4004	0	0	1	1	0	10	10	2	0	519	77	59	9.5	1	1	0.25	8.50	14	0	0	8	12	20	0	0	0	0	0	0
33	4	1	4104	0	1	1	11	1	11	111	2	1	501	83	83	20.0	0	1	1.25	10.00	32	1	0	8	120	140	0	0	0	0	1	0
34	4	1	4105	0	1	1	11	0	10	110	10	0	501	39	28	13.0	1	0	0.00	0.00	43	0	1	2	4	55	0	0	0	0	0	0
35	4	1	4106	0	1	0	10	1	1	101	2	1	501	80	56	14.0	0	0	0.00	6.00	30	0	0	14	120	227	0	0	0	0	0	0
36	4	1	4107	0	1	0	10	0	0	100	11	0	501	116	0	21.0	0	1	2.00	4.00	36	0	0	1	10	18	0	0	0	1	0	0
37	4	1	4108	0	1	1	11	1	11	111	3	1	501	119	119	14.0	0	0	0.00	5.00	30	1	0	79	240	480	0	12	0	0	3	0
38	4	1	4109	0	1	1	11	0	10	110	3	1	501	120	34	20.0	0	1	1.50	5.17	28	0	0	1	5	14	0	0	0	0	0	0

OBS	RATER	EXPRE1	EXPRE2	EXPRE3	EXPRE4	RACE	EXPRE5	EXPRE6	EXPRE7	EXPRE8	EXPRE9	EXB11	EXB12	EXB13	EXB14	EXB15	EXB16	EXB17	EXB18	EXB19	EXB21	EXB22	EXB23	EXB24	EXB25	EXB26	EXB27	EXB28	EXB29	EAT	LAT2	INT
20	1	0	0	0	100	1	0	0	0	0	0	0	0	0	50	50	0	0	0	0	0	0	0	0	100	0	0	0	0	1	9	85.714
21	0	0	0	34	33	1	33	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	100	0	0	0	1	120	96.610
22	0	0	0	0	0	1	100	0	0	0	0	0	0	26	34	34	6	0	0	0	0	8	34	33	25	0	0	0	0	0	240	0.000
23	1	0	0	0	0	1	100	0	0	0	0	0	11	11	39	33	6	0	0	0	0	20	40	20	20	0	0	0	0	0	240	0.000
24	0	0	0	0	0	1	100	0	0	0	0	0	0	0	50	50	0	0	0	0	0	0	0	100	0	0	0	0	0	1	120	5.479
25	0	0	0	0	33	1	67	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	50	50	0	0	0	1	9	28.571
26	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	50	0	50	0	0	1	11	28.571
27	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	56	30.000
28	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	72	30.000
29	0	0	0	0	0	1	100	0	0	0	0	0	22	11	34	33	0	0	0	0	0	12	50	13	25	0	0	0	0	0	240	0.000
30	1	0	0	0	0	1	100	0	0	0	0	0	13	25	0	50	12	0	0	0	23	31	0	8	38	0	0	0	0	0	240	0.000
31	0	0	0	0	0	1	90	10	0	0	0	0	0	0	33	67	0	0	0	0	0	0	33	0	67	0	0	0	0	1	120	6.667
32	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	33	67	0	0	0	0	1	8	23.377
33	0	0	0	0	0	0	100	0	0	0	0	0	0	0	25	50	25	0	0	0	0	0	0	0	50	50	0	0	0	0	20	0.000
34	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	50	50	0	0	0	1	51	28.205
35	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	34	33	33	0	0	0	0	0	0	43	43	14	0	0	1	107	30.000
36	0	0	0	0	0	0	40	40	20	0	0	0	0	0	0	0	67	33	0	0	0	0	0	0	100	0	0	0	0	1	8	100.000
37	0	0	0	0	0	1	100	0	0	0	0	0	14	14	43	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	240	0.000
38	0	0	0	0	33	1	67	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	9	71.667

OBS	CENTER	GROUP	SN	RATECODE	AGE	TAT	AGETAT	VIS	COND	EIGHTSET	FOODCODE	PRESCODE	TSTDAT	PREWTG	POSTWTG	AGEMO	GENDER	BREAST	BREASTMO	SOLIDMO	VARIETY	ALLERGY	HISTALRG	TOUCHSEC	B1	B2	SPITB2	PUSHB1	PUSHB2	FLEXB0	FLEXB1	FLEXB2
39	6	0	6001	0	0	0	0	0	0	0	7	0	507	87	77	8.5	1	1	3.50	6.00	18	1	1	4	25	66	0	0	0	0	0	0
40	6	0	6002	0	0	1	1	1	11	11	3	0	507	143	91	12.0	1	0	12.00	6.00	30	1	0	14	39	52	0	0	0	0	0	0
41	6	0	6003	0	0	1	1	0	10	10	8	0	507	113	60	10.0	0	1	2.00	3.00	32	0	0	1	43	54	0	0	0	0	0	0
42	6	0	6004	0	0	0	0	1	1	1	1	0	508	75	75	12.0	1	1	1.25	4.00	22	0	0	7	240	480	0	0	1	0	0	0
43	6	0	6005	2	0	0	0	0	0	0	2	0	514	90	61	12.0	1	1	11.00	4.00	29	0	0	38	42	54	0	0	0	0	0	0
44	6	0	6005	1	0	0	0	0	0	0	2	0	514	90	61	12.0	1	1	11.00	4.00	29	0	0	37	41	52	0	0	0	0	0	0
45	6	0	6006	0	0	1	1	1	11	11	2	0	507	83	65	7.0	1	1	7.00	3.00	22	1	0	8	28	69	0	0	0	0	0	0
46	6	0	6007	0	0	1	1	0	10	10	10	0	507	33	32	10.5	1	1	10.50	5.50	45	0	0	49	67	87	0	0	10	0	0	0
47	6	1	6102	0	1	0	10	0	0	100	2	0	508	92	90	20.0	1	1	1.50	5.17	24	0	0	7	240	480	0	0	2	0	1	0
48	6	1	6103	0	1	1	11	1	11	111	7	0	508	82	80	24.0	0	1	4.00	6.00	29	0	0	1	10	43	0	0	0	0	0	0

49	6	1	6105	0	1	0	10	1	1	101	8	0	508	99	88	14.5	1	1	5.00	9.00	48	0	0	24	66	150	0	0	1	0	0	0
50	6	1	6106	0	1	0	10	0	0	100	2	0	508	98	98	20.0	0	1	2.00	4.00	38	0	0	7	240	480	0	2	2	0	1	0
51	6	1	6107	0	1	1	11	1	11	111	7	0	508	95	50	20.0	0	1	5.00	4.00	39	0	0	3	8	16	0	0	0	0	0	0
52	6	1	6108	2	1	0	10	1	1	101	9	2	508	24	24	13.0	1	1	2.00	6.00	30	0	0	4	240	480	0	0	0	0	0	0
53	6	1	6108	1	1	0	10	1	1	101	9	2	508	24	24	13.0	1	1	2.00	6.00	30	0	0	3	240	480	0	0	0	0	0	0
54	6	1	6109	0	1	1	11	1	11	111	6	0	522	74	69	15.0	1	1	12.00	5.00	21	0	0	7	14	145	0	0	0	0	0	0
55	7	0	7001	0	0	1	1	1	11	11	1	3	526	75	53	11.0	0	0	0.00	3.00	20	0	1	2	21	53	0	0	0	0	0	0
56	7	0	7002	0	0	0	0	1	1	1	1	3	526	85	78	11.0	0	1	2.50	3.00	15	0	0	1	120	240	0	2	0	0	0	0
57	8	0	8001	0	0	0	0	0	0	0	1	0	602	64	57	12.0	0	1	6.50	6.00	26	0	0	2	11	27	1	0	0	0	0	0

OBS	RATER	EXPRE1	EXPRE2	EXPRE3	EXPRE4	PRACE	EXPRE5	EXPRE6	EXPRE7	EXPRE8	EXPRE9	EXB11	EXB12	EXB13	EXB14	EXB15	EXB16	EXB17	EXB18	EXB19	EXB21	EXB22	EXB23	EXB24	EXB25	EXB26	EXB27	EXB28	EXB29	EAT	LAT2	INT
39	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	67	0	33	0	0	0	0	0	0	50	50	0	0	0	1	41	11.4943
40	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	13	36.3636
41	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	11	46.9027
42	1	0	0	0	0	1	100	0	0	0	0	0	0	0	31	54	15	0	0	0	0	0	0	0	0	0	0	0	0	0	240	0.0000
43	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	12	32.2222
44	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	11	32.2222
45	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	41	21.6867
46	1	0	0	0	0	1	100	0	0	0	0	0	0	0	44	56	0	0	0	0	0	0	0	50	50	0	0	0	0	1	20	3.0303
47	1	0	0	0	0	1	100	0	0	0	0	0	0	17	33	33	17	0	0	0	13	12	13	25	37	0	0	0	0	1	240	2.1739
48	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	33	2.4390
49	1	0	0	0	0	1	100	0	0	0	0	0	0	0	20	60	20	0	0	0	0	0	0	50	50	0	0	0	0	1	84	11.1111
50	1	0	0	0	0	1	100	0	0	0	0	0	0	0	33	67	0	0	0	0	0	0	0	0	100	0	0	0	0	0	240	0.0000
51	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	8	47.3684
52	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	240	0.0000
53	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	240	0.0000
54	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	131	6.7568
55	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	32	29.3333
56	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	33	0	67	0	0	0	0	1	120	8.2353
57	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	50	50	0	0	0	0	1	16	10.9375

OBS	CENTER	GROUP	SN	RATECODE	AGE	TAT	AGETAT	VIS	COND	EIGHTSET	FOODCODE	PRESCODE	TSTDAT	PREWTG	POSTWTG	AGEMO	GENDER	BREAST	BREASTMO	SOLIDMO	VARIETY	ALLERGY	HISTALRG	TOUCHSEC	B1	B2	SPITB2	PUSHB1	PUSHB2	FLEXB0	FLEXB1	FLEXB2
58	8	1	8101	0	1	1	11	0	10	110	7	0	602	71	67	19.0	1	0	0.00	5.17	27	0	0	1	3	18	1	0	0	0	0	0

59	8	1	8102	0	1	0	10	1	1	101	7	1	602	82	82	23.0	0	0	0.00	1.00	24	0	0	24	240	480	0	0	0	0	0	1
60	8	1	8103	0	1	0	10	0	0	100	5	0	602	79	76	21.0	1	0	0.00	6.75	30	0	0	1	92	240	0	0	3	0	0	0
61	9	0	9001	0	0	0	0	0	0	0	7	0	603	77	64	9.0	0	1	2.00	6.00	27	1	1	1	28	82	1	0	0	0	0	0
62	9	1	9101	2	1	0	10	0	0	100	7	0	603	75	52	18.0	0	0	0.00	6.00	41	0	0	19	23	77	0	0	0	0	0	0
63	9	1	9101	1	1	0	10	0	0	100	7	0	603	75	52	18.0	0	0	0.00	6.00	41	0	0	18	24	77	0	0	0	0	0	0
64	10	0	10001	0	0	1	1	1	11	11	5	1	610	80	80	7.0	1	1	2.00	6.00	14	0	0	0	240	480	0	0	2	0	4	2
65	10	0	10002	0	0	0	0	1	1	1	7	0	604	78	59	12.0	0	0	0.00	3.00	20	0	0	0	120	240	0	0	2	0	4	2
66	10	0	10004	0	0	0	0	1	1	1	7	0	604	81	70	10.0	0	0	0.00	4.00	15	0	0	36	152	218	0	0	0	0	0	0
67	10	0	10005	0	0	1	1	0	10	10	3	0	610	130	110	11.5	1	0	0.00	5.00	27	0	0	2	78	83	0	0	0	0	0	0
68	10	0	10006	0	0	1	1	1	11	11	2	1	610	84	76	8.0	1	1	2.00	4.00	13	0	0	1	13	76	0	0	0	0	0	0
69	10	1	10101	0	1	1	11	1	11	111	7	0	604	85	69	15.0	0	1	1.50	5.50	44	0	0	4	7	240	2	0	3	0	0	0
70	10	1	10102	1	1	0	10	1	1	101	7	0	604	87	80	19.0	1	0	0.00	9.00	29	1	1	47	48	83	0	0	0	0	0	0
71	10	1	10102	2	1	0	10	1	1	101	7	0	604	87	80	19.0	1	0	0.00	9.00	29	1	1	45	53	240	0	0	0	0	0	0
72	11	0	11001	0	0	1	1	1	11	11	3	0	616	109	109	8.0	1	0	0.00	5.17	14	0	0	19	240	480	0	0	1	0	0	0
73	11	0	11003	0	0	1	1	0	10	10	2	0	616	69	67	12.0	0	1	0.25	3.00	20	0	0	0	120	240	0	0	0	0	0	0
74	11	0	11004	0	0	0	0	0	0	0	5	0	616	72	62	9.0	1	1	3.00	5.00	22	0	0	2	31	47	0	0	0	0	0	0
75	12	0	12001	0	0	1	1	0	10	10	2	0	617	84	63	8.0	1	0	0.00	6.00	17	0	0	0	6	34	0	0	0	0	0	0
76	12	0	12002	0	0	0	0	1	1	1	5	0	617	77	66	10.0	1	1	9.00	4.00	39	0	0	8	34	44	0	0	0	0	0	0

OBS	RATER	EXPRE1	EXPRE2	EXPRE3	EXPRE4	RACE	EXPRE5	EXPRE6	EXPRE7	EXPRE8	EXPRE9	EXB11	EXB12	EXB13	EXB14	EXB15	EXB16	EXB17	EXB18	EXB19	EXB21	EXB22	EXB23	EXB24	EXB25	EXB26	EXB27	EXB28	EXB29	EAT	LAT2	INT
58	1	0	0	0	50	1	50	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	50	50	0	0	0	0	1	15	5.6338
59	1	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	240	0.0000
60	1	0	0	0	0	1	100	0	0	0	0	0	0	20	20	60	0	0	0	0	0	0	0	40	60	0	0	0	0	1	148	3.7975
61	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	50	50	0	0	0	0	1	54	16.8831
62	0	0	0	0	0	1	100	0	0	0	0	0	0	0	50	50	0	0	0	0	0	0	0	33	67	0	0	0	0	1	54	30.6667
63	1	0	0	0	0	1	100	0	0	0	0	0	0	0	33	67	0	0	0	0	0	0	0	50	50	0	0	0	0	1	53	30.6667
64	0	0	0	0	0	1	100	0	0	0	0	0	34	33	0	33	0	0	0	0	0	50	25	0	25	0	0	0	0	0	240	0.0000
65	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	50	33	0	17	0	0	50	25	0	25	0	0	0	0	1	120	24.3590
66	1	0	0	0	100	1	0	0	0	0	0	0	13	13	50	24	0	0	0	0	0	0	0	0	33	17	17	33	0	1	66	13.5802
67	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	57	29	14	0	0	0	0	0	0	100	0	0	0	0	1	5	15.5846
68	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	63	9.5238
69	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	12	38	50	0	0	0	0	1	233	18.8235
70	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	35	8.0460
71	1	0	0	0	0	1	100	0	0	0	0	0	0	0	33	67	0	0	0	0	0	0	0	0	100	0	0	0	0	1	187	8.0460
72	1	0	0	0	0	1	100	0	0	0	0	0	0	0	40	60	0	0	0	0	0	0	0	0	100	0	0	0	0	0	240	0.0000
73	0	0	0	0	0	1	100	0	0	0	0	0	0	0	50	50	0	0	0	0	0	0	0	33	67	0	0	0	0	1	120	2.8986
74	0	0	0	0	0	1	50	50	0	0	0	0	0	0	0	50	50	0	0	0	0	0	0	0	100	0	0	0	0	1	16	13.8889
75	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	28	25.0000
76	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	10(	0	0	0	0	1	10	14.2857

DATA 11:13 Tuesday, March 2, 1993 5

R E F P B H T

OBS	CENTER	GROUP	SN	ATECODE	AGE	TAT	AGETAT	VIS	COND	IGHTSET	OODCODE	RESCODE	TSTDAT	PREWTG	POSTWTG	AGEMO	GENDER	BREAST	REASTHO	SOLIDMO	VARIETY	ALLERGY	ISTALRG	OUCHSEC	B1	B2	SPITB2	PUSHB1	PUSHB2	FLEXB0	FLEXB1	FLEXB2
77	12	0	12003	0	0	0	0	0	0	0	2	0	618	95	70	12.0	0	1	4.00	6.00	27	1	1	9	132	159	0	0	0	0	0	0
78	13	0	13001	0	0	0	0	1	1	1	5	0	626	70	58	11.0	0	1	3.50	4.00	18	0	0	16	18	44	0	0	0	0	0	0
79	13	0	13002	0	0	0	0	0	0	0	5	0	626	64	46	8.0	0	0	0.00	5.00	22	0	0	1	33	55	0	1	0	0	0	0
80	13	0	13003	0	0	0	0	1	1	1	5	2	626	72	42	12.0	1	1	2.00	9.00	19	0	0	1	8	26	0	0	0	0	0	0

OBS	RATER	EXPRE1	EXPRE2	EXPRE3	EXPRE4	RACE	EXPRE5	EXPRE6	EXPRE7	EXPRE8	EXPRE9	EXB11	EXB12	EXB13	EXB14	EXB15	EXB16	EXB17	EXB18	EXB19	EXB21	EXB22	EXB23	EXB24	EXB25	EXB26	EXB27	EXB28	EXB29	EAT	LAT2	INT
77	1	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	0	0	0	0	1	27	26.3158
78	0	0	0	0	0	1	50	50	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	64	36	0	0	0	1	26	17.1429
79	0	0	0	0	0	0	50	0	50	0	0	0	0	0	50	50	0	0	0	0	0	0	0	34	33	33	0	0	0	1	22	28.1250
80	0	0	0	0	0	1	100	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	50	50	0	0	0	0	1	18	41.6667

Vita

Lera Joyce Johnson, Ph.D.

Professional Address: Department of Psychology
Virginia Polytechnic Institute
& State University
Blacksburg, Va. 24061-0436
(703) 231-6581

Home Address: 1926 Oxford Ave. SW
Roanoke, VA. 24015-5117
(703) 344 5089

Birthdate 03-13-53

Education:

Ph.D. 1993
Virginia Polytechnic Institute & State University
Major field: Developmental Psychology with an emphasis in Eating Behavior
Major Advisor: Joseph J. Franchina, Ph.D.
Dissertation: Effects of novel ingesta from novel presenters on food acceptance in infants of different ages.

M.A. 1988 Hollins College
Major field: Experimental Psychology
Thesis: Metamemory and Strategy Acquisition
Major Advisor: George Ledger, Ph.D.

B.A. 1974 University of Puget Sound, Cum Laude
Major field: Elementary Education
Licensed teacher certification:
Collegiate Professional NK-7

Honors:
Full Fellowship with Stipend, Hollins College
Psi Chi, Hollins College, 1988
Phi Kappa Phi, Univ. of Puget Sound Chapter
Departmental Merit, Education, Univ. Puget Sound
Xi Theta Chi, (Honorary Fraternity, Foreign Languages) Roanoke College, 1972
Dean's List, Roanoke College

Professional Associations:
American Psychological Society, student member
Southeastern Psychological Association, student member
American Psychological Association, student member

Professional Experience and Employment:

Teaching Experience

Spring, 1993
Adjunct Professor, Introductory Psychology
Life-span Development, Adolescent and Adult Development
Department of Social Sciences,
Virginia Western Community College, Roanoke, Va.
Department Head: W.T. Shirley, 703-857-7276

Fall, 1992
Adjunct Professor, Introductory Psychology,
Physiological Psychology, Department of Social Sciences,
Concord College, Athens, W.Va. Department Head:
Dr. John Seago, 304-384-5222

Adjunct Professor, Introductory Psychology,
Life-span Development, Conception to Middle Childhood
Department of Social Sciences,
Virginia Western Community College, Roanoke, Va.

Summer, 1992
Instructor, 2 sections of Study Skills, 1 of English
Grammar/ Special Education [LD], Upward Bound, VPI & SU
Program Director: Jimmie Johnson, 703-231-6911
Instructor, Computer Science, Better Information
Precollege Program, Office of Academic Enrichment,
VPI & SU Program Director: Delores Scott, 703-231-4133

Fall, 1990- Spring, 1992
Instructor, Developmental Psychology, Department of
Psychology; VPI & SU

Summer, 1991
Instructor of SAT Preparation, Office of Academic
Enrichment, VPI & SU

Spring, 1990
Graduate Teaching Assistant, Department of Psychology; VPI
& SU Instructor for Motivation Laboratory and Assistant
Lecturer for Motivation course

Fall, 1989
Graduate Teaching Assistant, Department of Psychology; VPI & SU. Instructor for Cognitive Psychology Laboratory

7/88, 7/89 Graduate Teaching Assistant, HollinSummer Program Department of Psychology; Hollins College Research assistant and Vivarium Supervisor

1988-89 Graduate Teaching Assistant, Dept. of Psychology; VPI & SU. Assistant lecturer for Introductory Psychology & Child Development course.

4/87-8/88
Teacher and diagnostician, Grades 1-12

1975-78 Roanoke City Schools, Fallon Park Elementary, Full time teacher, Third grade, open classroom

Spring, 1975 Roanoke County Schools, paraprofessional Special Class for Emotionally Disturbed Elementary students at Oak Grove Elementary School

Professional activities

1992 Charter Liason, Established APS Student Caucus, VPI & SU

1988 Critical literary review of Introductory Psychology Texts- Simon & Schuster

1987-88 Graduate Assistant to George Ledger, Ph.D.

Research Experience

January 1990 to March 1993
Research with Dr. Joseph J. Franchina: Intersensory transfer of novelty between food stimuli in hatchling chicks.

January 1990 to December 1991
Consultant, Weight-loss Program, Lewis-Gale Clinic, Salem, VA. Research and statistical analyses

Summer, 1990
Research Assistant, Day Care Project, Department of Developmental Psychology, University of Virginia, Charlottesville, Va., data collection

Presentations

Penn, C.Y., Lanter, J.E., Franchina, J.J., Johnson, L.J. (1992). Effects of taste concentration and amount of LiCl injection on aversion to visual cues in chicks (*Gallus Domesticus*). Midwestern Psychological Association. Chicago, Ill.

Franchina, J.J., Penn, C.Y., Lanter, J.E., Johnson, L.J. (1992). Effects of taste novelty and number of ingestive responses on aversion conditioning to visual cues in chicks (*Gallus Domesticus*). Midwestern Psychological Association. Chicago, Ill.

Johnson, L.J. & Franchina, J.J. (1991). Age-related changes in taste neophobia following ingestional and noningestional preexposure to visual cues in chicks (*Gallus Domesticus*). Eastern Psychological Association. New York City, N.Y.

Franchina, J.J., Leynes, P.A., and Johnson, L.J. (1991). Separate effects of aversion to visual and taste cues on drinking latencies: Belongingness reconsidered. Psychonomic Society. San Francisco, Ca.

Johnson, L.J. (1990). Obesity and weight loss. Virginia Developmental Forum, George Mason Univ.

Johnson, L.J. (1989). Effects of age, metamemorial knowledge and strategy training on free-recall performance. Southeastern Psychological Association. Washington, D.C.

Johnson, L.J. (1988). Metamemory and strategy acquisition. Annual Science Seminar. Hollins College, Roanoke, Va.