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BETWEEN THREE PAIRS OF
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CONSUMERS' PERCEPTIONS OF DIFFERENCES BETWEEN THREE PAIRS OF FOOD GROUPING CONSTRUCTS

By

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ABSTRACT

CONSUMERS' PERCEPTIONS OF DIFFERENCES BETWEEN THREE PAIRS OF FOOD GROUPING CONSTRUCTS

By

John Nicholas Kallas

This study is about consumer perceptions of food grouping constructs currently used in instructional food classification systems (food guides). The purpose of this study was two-fold: 1) to investigate consumer perceptions related to specific food grouping constructs, and 2) to test for perceptual differences between those food grouping constructs. The following three sets of food grouping constructs were tested for difference in hypothesis testing: "Vegetables" vs "Fruits"; "Beans" vs "Meat, Poultry, Fish"; and "Foods from Animals" vs "Foods from Plants". These were selected because they represent major construct differences between two widely distributed food guidance systems, the Daily Food Guide, and the EFNEP's Food Choices for Variety. The Daily Food Guide combines all three of the above construct pairs and is modeled after the Basic Four Food Groups. The EFNEP's Food Choices for Variety separates all three construct pairs. Preliminary research was conducted to determine attributes that consumers use to describe the similarities and differences between food grouping constructs. Final

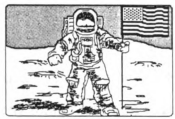
telephone survey research was conducted with 162 randomly selected adults from the mid-Michigan area. Respondents were asked to rate constructs directly against each other and according to 19 total attributes. Scales used for attribute ratings included percent estimate, direct magnitude estimation, and ratio paired comparisons. Hotelling's T^2, a multivariate t - test was conducted to test the following three hypotheses. Respondents perceive no difference between the constructs "Fruits" and "Vegetables", between the constructs "Beans" and "Meat, Poultry, Fish", and between the constructs "Foods from Animals" and "Foods from Plants". Two one-sample t - tests were conducted on direct measures of difference between constructs. The null hypothesis was rejected for all three multivariate tests at $p < .001$. It was also rejected for both univariate t -tests at $p < .001$. Further examination of attribute measures was done to determine which responses led to the rejection of the multivariate hypotheses. The results of this study indicate a need to rethink the traditional classification of foods done by nutrition educators.

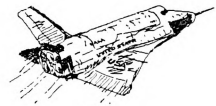
This dissertation is dedicated to

my family, friends, and

those devoted to understanding

the nature of the cosmos.





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SCIs = Simultaneous Confidence Intervals

MDS = Multidimensional Scaling

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CHAPTER 1

INTRODUCTION

This dissertation examines a fundamental issue in the science of nutrition education. That issue is, do traditional food groups used in public nutrition education reflect consumer perceptions[1]? In the narrow sense this research is a direct test of basic groupings used in conventional food guidance. In a broad sense, the issue in question is how people classify foods. Specifically, this dissertation examines and tests the following three questions. Are "Fruit" and "Vegetable" food grouping constructs[2] perceived by consumers to be similar enough to combine into a single "Fruit-Vegetable" group? Are "Meat, Poultry Fish" and "Bean" food grouping constructs perceived by consumers to be similar enough to combine into a single "Meat, Poultry, Fish, and Bean" group? And are "Food From Animal" and "Food From Plant" food grouping constructs perceived by consumers to be similar enough to mix within food groups?

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1 Perceptions are defined here as judgments of opinion, belief, or behavior regarding stimuli.

2 A ***construct*** is a concept that is deliberately and consciously invented or adopted for a special or scientific purpose. A ***concept*** expresses an abstraction formed by generalization from particulars. (Kerlinger, 1973)

The Problem

> There is no record in the nutrition literature of scientifically designed studies to test the usability[1] aspects of any food guide. (Light & Cronin, 1981)

The Basic Four Food Groups make up the fundamental components of the USDA's Daily Food Guide, and the National Dairy Council's Guide to Good Eating. These two have been the most widely disseminated food guidance systems in the U. S. since 1957. According to 1977-1978 National Food Consumption Survey data, only about three percent of the U.S. population's food consumption actually coincided with Basic Four recommendations. And over half of those who did, consumed excessive amounts[2] of fat (Crocetti & Guthrie, 1983). It is not known to what degree the Daily Food Guide's grouping scheme contributed to this "usability" problem.

The examination of consumer perceptions of food grouping constructs is important for the following reasons: 1) It addresses a recognized problem within the Nutrition Education research community. 2) Observations indicate that certain food grouping constructs are combinations of unrelated constructs. 3) Research indicates that certain food grouping constructs are combinations of unrelated constructs. 4) Education and communication theorists indicate that, under certain circumstances, concepts that do not

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1 "Usability" was described as the qualities of being "understood", "remembered", and "effectively used" by the intended audiences (Light & Cronin, 1981).

2 Excessive amounts of fat were interpreted as anything over 35% of total caloric intake (Crocetti & Guthrie, 1983).

reflect consumer perceptions may not be recognized within their framework of thinking or encoded into memory, and 5) It may be cost effective if more effective[1] and efficient[2] food guidance systems can be developed.

The examination of consumer perceptions of food grouping constructs addresses a recognized problem within the Nutrition Education research community. After a careful examination of the literature on food guidance, Light and Cronin (1981) made the statement cited on page 2. It was their position that various aspects of food guide usability should be investigated. They promoted the assessment of "comprehensibility", "memorability", and "motivational appeal" of food guides. They said that, "Ingenious, technically accurate food guides fail if they cannot be understood, remembered, and effectively used" Light and Cronin (1981). The authors did not operationally define these terms. They therefore, will be accepted as conventional language with no special scientific referent. Comprehension, memory and motivation, however, are aspects of learners. One can infer then from these statements that the charge has been given to assess audience characteristics regarding food guides. Food guides are composed of food grouping concepts, the focus of this research.

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1 An "effective" food guidance system is defined here as one that accomplishes what the educator intended for it to accomplish when employed as intended. It could merely transmit information or motivate to action.

2 An "efficient" message is defined here as one that produces relatively greater intended effect for less cost in time, effort, and money by educators and their audience.

Other researchers emphasized the need to focus on audience characteristics and to develop food grouping systems that were more in line with consumer perceptions (Lachance, 1981; Dodds, 1981; Michela & Contento, 1984; Axelson et al., 1986). Schutz et al. (1975), indicated that most food guidance systems were designed to meet the special needs of the classifier rather than to reflect the way the food users themselves would make groupings; "preconceived ideas"[1] of users were seen as important in the development of food and food use classification systems. Fewster et al. (1973), assessed the connotative meanings of foods and some food groups. It was their position that the study of meanings provided information about audiences that would, "help nutritionists define communication goals and plan nutrition education programs." They recommended further research regarding the measurement of meanings for all food groups and for samples more representative of the general population.

Priorities for nutrition education research were identified at the 1980 Penn State Conferences titled Directions for Nutrition Education Research (Sims & Light, 1980). In the area of Community Nutrition Education, research priorities included studying target group characteristics, and methodologies for nutrition interventions. It was thought that information on how target group members classify, organize, or structure information might provide clues to develop a more precise message.

Descriptive research was also listed as a priority; particularly, hypothesis testing or theory-generating research to systematically describe

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1 The phrase, "preconceived ideas", was interpreted as conventional language with no special scientific referent.

how people classify foods. Priority was placed on looking at "self-imposed" systems of food classifications. These data could then be used to contribute to theories in consumer food behavior, habits, patterns, and usage. These systems could be compared to other food systems developed by researchers from nutrition, marketing, advertising, and education. This basic research on audience assessment, particularly on consumer perceptions, is necessary to develop a conceptual framework from which to build theories and develop nutrition education efforts. (Sims & Light, 1980)

Nutrition Communication priorities determined by Conference participants included 1) obtaining a better "understanding" of the target audience and 2) examining characteristics of nutrition interventions. Panelists stated that "Before design of intervention programs, nutrition-communication researchers must increase their understanding of receiver motivations, predispositions, and perceptions". Panelists also thought that knowledge of target audience perceptions would provide a basis on which to evaluate consumer responses to educational messages. (Sims & Light, 1980)

The examination of consumer perceptions of food grouping constructs is important because general observations indicate differences in common language and foodways[1] within currently grouped constructs. "Fruits" and

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1 "Foodways" are standardized practices connected with food that are reinforced by society. They have to do with "how food is acquired, which foods are selected for consumption, how they are prepared for eating, who eats them, with whom, when, how, and in what quantity they are eaten" (Gifft et al., 1972).

"Vegetables" are grouped together in the Daily Food Guide. This arrangement does not appear to reflect everyday life. For example, in this researcher's experience, if persons ask for a "Fruit" for a snack they do not expect to receive broccoli or cabbage. If they ask for a "Vegetable" to eat with their main dish they would not expect to receive a banana. In common language and foodway contexts, "Fruit" and "Vegetable" appear to represent distinctly different classes of foods. This is evidenced by the occasional debate on whether a tomato is a "Vegetable" or a "Fruit." In this case where there might seem little difference, people want to know which of the two groups the tomato belongs to. People do not verbalize combined "Vegetable-Fruit" conceptions. Nutrition professionals use these terms separately unless formally conversing or writing about food guidance. In terms of these non-experimental observations, "Vegetables" do not show equivalence to "Fruits." Terms like "Produce" or "Fresh Foods" that may combine "Fruits" and "Vegetables" have not been found to represent natural language concepts of consumers (Michela and Contento, 1984). The term "Produce" may be used predominantly in the context of supermarkets. The term "Fresh Foods" may only be used by health professionals. The same principles of difference could be claimed for "Meat, Poultry, Fish" and "Bean" food grouping constructs. The only time they are combined appears to be in technical discussions about food guidance, vegetarianism, or protein. "Foods From Plants" and "Foods From Animals" do not appear to be natural language concepts, but evidence demonstrating their distinction does exist (Michela and Contento, 1984; Axelson et al., 1986). Evidence for conceptual differences exhibited by consumers, between all three pairs of

food grouping constructs, will be discussed in the literature review.

Nutrition scientists have been primarily responsible for the creation and design of food guidance systems (e.g., Page and Phipard, 1957; Pennington, 1981; Dodds, 1981; Gillespie, 1984). Nutrition scientists are highly educated people who have had years of intensive formal training in their specialized field. It is reasonable to believe that this training would have an effect on their perceptions of foods and how they classify them. Even junior level nutrition nutrition and dietetic students used professional or scientific constructs more often and construed foods quite differently from students in other majors (Worsley, 1980).

The examination of consumer perceptions of food grouping constructs is also important because of inferences that can be drawn from statements of theorists in education and communication sciences. Under conditions of ordinary exposure[1] to food guidance, concepts that do not reflect consumer perceptions may not be attended to, encoded into memory, or reinforced by everyday messages. Consumers are not receptive to all forms of information. Consumer characteristics will affect what information is attended to, how it is encoded into meaning , and whether it is retained for later expression. Berlo (1960), a communications scientist stressed the importance of the source (encoder) taking the receiver (decoder) into account for effective communication. He wrote:

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1 Nutrition education conducted in the schools or through programs like the Expanded Food and Nutrition Education Program is only designed to provide basic information to consumers. The resources are not expended to change foodways or how people organize their thoughts about foods.

> When the source chooses a code for his message, he must choose one which is known to his receiver. When the source selects content in order to reflect his purpose, he selects content that will be meaningful to his receiver. When he treats the message in any way, part of his treatment is determined by his analysis of his receiver's communication (decoding) skills, his attitudes, his knowledge, and his place in a social-cultural context. The only justification for the existence of a source, for the occurrence of communication, is the receiver, the target at whom everything is aimed. (Berlo, 1960)

Berlo (1960) stressed the importance of basing communication on evidence of meaning recognized by receivers. He contends that great care should be exercised to arrange message units so that they will have meaning. For messages to have meaning they must follow the vocabulary, syntax, and structure of the current use of language.

> Effective and efficient encoding (of messages by senders)[1] requires care in watching for misinterpretations, precision in wording and structuring the message, and knowledge of current usage on the language level at which you are communicating. Communication is hard work; it implies rigor. All that is suggested is that prescriptions on the selection and arrangement of message units should be based on (a) evidence as to the clearest and most effective methods for selecting and arranging these units, and (b) general usage by the people for whom the message is intended. Prescriptions should not be based on moralistic or authoritarian dogma as to what is "proper" or "good." (Berlo, 1960)

Accordingly, food guides designed by nutrition educators should take into account more than just the content of the message (nutrient associations and meal planning recommendations). In order for food guides to be effective and efficient communication devices their instructional designs

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1 The content of these parentheses was not part of Berlo's quote.

should be based on assessments of audience perceptions. Perceptions to be assessed regard the foods to be included, how they are combined into meaningful groups, and the overall structure of the message.

Gagné (1985), an education scientist, developed a theory of instruction that also stressed the role of the learner. It is his thinking that both internal and external conditions of learning must be attended to if learning is to take place. Internal conditions involve organized contents recovered from memory that affect how external stimuli are interpreted, processed and remembered. Previously learned capabilities are internal conditions. External conditions involve the stimulus situation that may initiate and influence learning. Gagné stressed the importance of making external stimuli that will make contact with the organized knowledge and learned capabilities already in the learner's possession in order to provide a meaningful context for learning. He stated that:

> New verbal information needs to "make contact" with the organized knowledge that is already in the learner's memory. If names and labels are to be learned, associating them with others that are already learned is known to be effective. ... Whatever method is used to activate internal processes, the function served by these external events is obviously to transform a nonmeaningful stimulus (a label to be learned) into one that is associated with meaningful information already available to the learner. Thus the new label is effectively encoded, stored in long-term memory, and can be more readily retrieved when needed. (Gagné, 1985)

According to Gagné (1985), external stimuli that do not "make contact" with the internal conditions of learners may not be attended to, encoded, or remembered in the way anticipated. The function served by food groups is to

transform nonmeaningful[1] stimuli (nutrient content or meal planning information) into something that is associated with meaningful information already available to consumers. That meaningful information is how consumers themselves group foods. Investigation of audience perceptions regarding food grouping constructs is necessary to establish an indication of the organized knowledge already available to consumers. After this is done, educated decisions can be made as to how foods should be grouped for best reception by consumers.

The examination of consumer perceptions of food grouping constructs is important because what evidence there is for a description of lay perceptions' of food or food related concepts shows limited correspondence to traditional food guide design (Pilgrim & Kamen, 1959; Schutz et al., 1972; Fewster et al., 1973; Jellinek, 1973; Schutz et al., 1975; Michela & Contento, 1984; Axelson et al., 1986). This issue is covered extensively in Chapter two.

The examination of consumer perceptions of food grouping constructs is important because of potential health benefits and savings in time, money, person-power, and other resources. If factors of group membership are eventually found to make a difference in the effectiveness and efficiency of food guidance systems improving group membership would benefit consumers in several ways. More effective and efficient food grouping

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1 Nutrient content and meal planning information are not meaningful, in this use of the word, without the context that foods provide.

constructs would, by definition, enable a greater percentage of persons to improve their eating patterns and/or recognition of nutrient linked foods. This, of course, depends on consumer effort expended, but at least more people would be enabled. Guides based on consumer perceptions would require less time investment on the part of one-to-one information providers because consumers would grasp the information in less time with greater understanding. Information that fits within a framework of common knowledge may become part of that common knowledge. Information on nutrients or meal planning that fits within a framework of common knowledge about food groups, may itself become common knowledge and transmitted through informal information networks. Institutions like the USDA and the National Dairy Council, which disseminate food guidance information, would get more education for the dollar. Between 1984 and May of 1987, the National Dairy Council has distributed approximately 419 thousand dollars worth of its Guide to Good Eating[1] mini posters. The USDA has spent at least one million publishing its Daily Food Guide since 1979[2]. These amounts represent a considerable monetary investment in materials alone.

Synopsis of Past Research on Consumer Perceptions of Foods

Prior to this study, no research had been devised to test consumer perceptions of different food groupings for equivalence. Studies have,

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1 Lewis, M.: Personal Communication. May 12, 1987. National Dairy Council, Nutrition Education Division, 6300 N. River Road, Rosemont, Illinois.

2 Howard, J.: Personal Communication. April 4, 1987. Printing Specialist, Food and Nutrition Service, USDA, Alexandria, Virginia.

however, explored perceptions of individual foods. Three basic techniques have been used to explore these perceptions. They were: direct ratings of foods in terms of preference or appropriateness for particular eating situations, explorations on the underlying meaning of foods using factor analysis, and multidimensional scaling. Each kind of research has contributed to our understanding of the meaning of foods and the associated cognitive structures.

Direct rating studies (e.g., Schutz et al., 1972; Fewster et al., 1973; Jellinek, 1973; Schutz et al., 1975) are those which ask the following kind of question: On a scale from 1 to 7, with 1 being appropriate[1] and 7 being inappropriate, how appropriate are oranges as a main dish? When food grouping concepts are scaled against attributes[2], it gives us an idea of what characteristics define those concepts. For example, fruits may be eaten for breakfast, are good-for-you, and low in fat. Characterizations of concepts could be cataloged to help provide profiles suitable for comparison with other profiled concepts.

Explorations on the underlying meaning of foods have been done by rating individual foods by preference, appropriateness for different eating situations, or rated directly against certain attributes (e.g., Pilgrim and Kamen, 1959; Schutz et al., 1972; Jellinek, 1973; Fewster et al., 1973; Schutz et al., 1975; Dalton et al, 1986). These scores are then analyzed for

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1 "Appropriateness" was undefined and therefore interpreted as conventional language with no special scientific referent.

2 An attribute is a characteristic or fundamental property used to describe an object or concept. Attributes have also been called "features" and, "characteristics". (Hulse, 1980)

underlying factors assumed to represent the connotative meaning of foods. Underlying attributes that are verified empirically could then be used to compare concepts.

Foods have been mapped in multidimensional space according to measures of their difference or similarity (e.g.s., Michela and Contento, 1984; Axelson et al., 1986). This kind of analysis provides a visual configuration in space of food concepts and their relationship to each other in the form of distance. Distance is a metaphor for difference. The closer two concepts, the more similar they are; the more distant, the more different. One benefit of this type of mapping is that a cluster analysis can be done on the configuration of concepts. This can give a relative estimation of the foods that are similar enough to group together as well as an indication of foods that are relatively distant.

All of these studies have contributed to our understanding of foods and their classification. In contrast to the current research, they have not provided a test for differences or membership of current constructs.

Introduction To The Current Research

The primary objective of this study was to test for differences within currently accepted food grouping constructs. The Expanded Food and Nutrition Education Program (EFNEP) Food Choices For Variety (Food Planner) (Figure 1) is a food guidance system devised to overcome, what its developers perceived to be, limitations of the basic four design (Kallas, 1984). The EFNEP Food Planner design was based on the assumptions that its low income audience did not group "Fruits" and "Vegetables; "Meats"

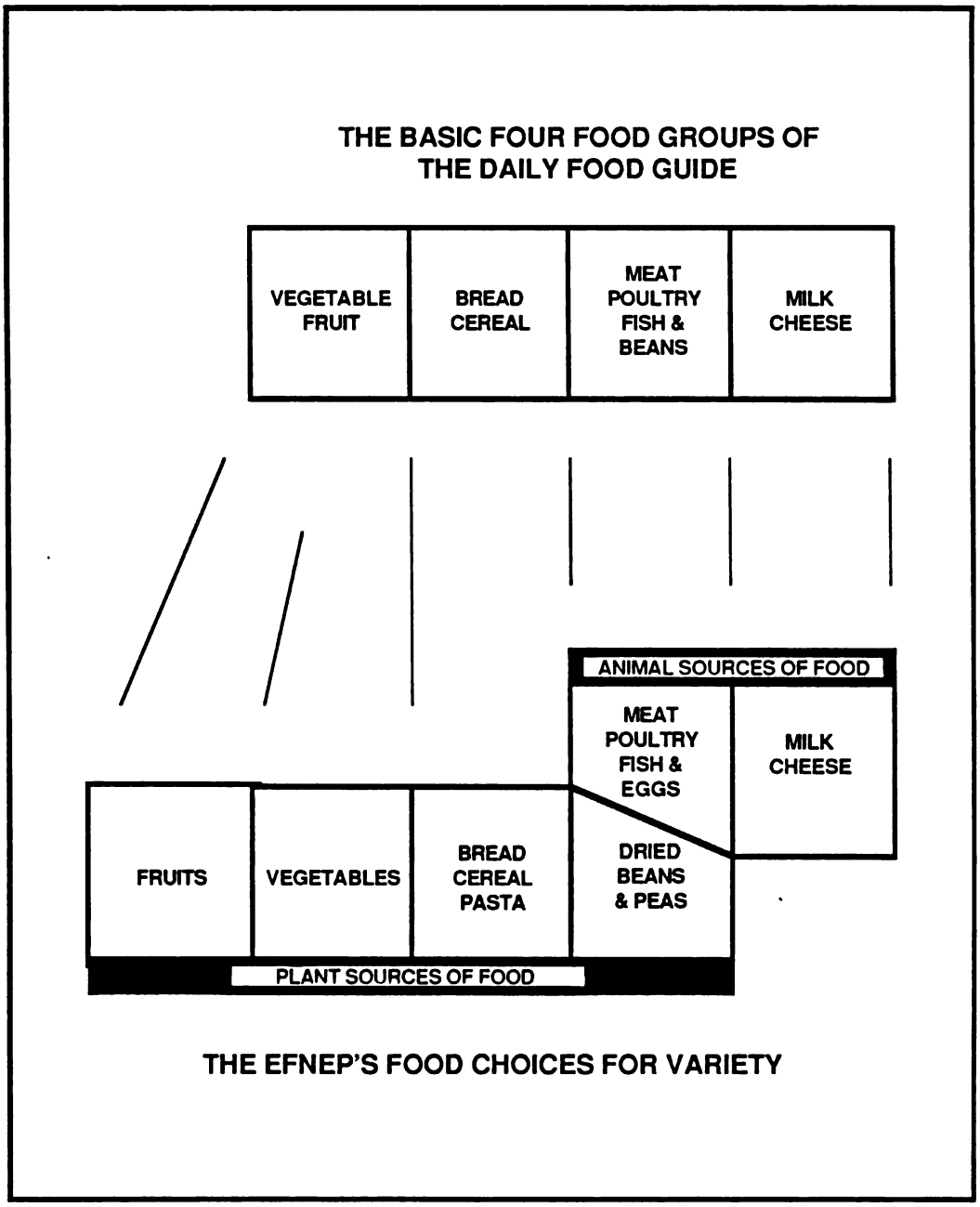

Figure 1. FOOD GROUP MEMBERSHIP CONTRASTED.
The Basic Four Food Groups of the Daily Food Guide and the EFNEP's Food Choices For Variety show contrasting designs for representing food group membership.

and "Beans" or "Plant" and "Animal" sources of foods in their everyday foodways. The design the EFNEP chose is different from Daily Food Guide in its assumptions about how consumers view food groupings. The lack of scientifically designed studies to test food grouping assumptions, the initial evidence from the literature indicating disagreement with the Basic Four design, and the now national dissemination of the untested EFNEP Food Planner provided the instigation for the research questions addressed in the current study.

Food grouping constructs used as stimuli throughout this study were the following. The first four of these constructs were created by splitting two of the Daily Food Guide groupings. The last two were created from the EFNEP Food Planner's supra-groupings: "Plant Sources of Foods" and "Animal Sources of Foods." Preliminary research conducted for the current project showed this wording to be difficult to interpret without direct reference to the Food Planner. Consequently these stimuli were condensed to the "Foods From Animals" and "Plants" forms seen below.

1) "Fruits"
2) "Vegetables"
3) "Meat, Poultry, Fish"
4) "Beans"
5) "Foods from Animals"
6) "Foods from Plants"

The purpose of this research is to investigate consumer perceptions of food groupings as represented in the list above. To provide nutrition educators with information that they can use to develop audience sensitive

nutrition messages. Specifically, information generated by this research should give researchers empirical data by which to evaluate grouping schemes in their instructional designs.

Hypotheses

To determine if certain traditional food grouping constructs were composites of unrelated food grouping constructs the following hypotheses were tested:

According to perceptions measured in this study...

1. Ho : Respondents perceive no difference between the constructs "Fruits" and "Vegetables."
2. Ho : Respondents perceive no difference between the constructs "Meat, Poultry, Fish" and "Beans."
3. Ho : Respondents perceive no difference between the constructs; "Food from Animals" and "Food from Plants."

These hypotheses test the Basic 4 representation of food groupings. Acceptance of these null hypotheses would represent support for the Daily Food Guide's food grouping constructs. Rejection of the null hypotheses would represent support for the EFNEP Food Choices of Variety's food grouping constructs.

"Meat Poultry Fish" and "Meats" will be used interchangeably hereafter in this dissertation.

Research Objectives

This dissertation provides a conceptual framework within which food grouping constructs can be tested for equivalence. The objectives of this research are to: 1) Devise an operational definition for food grouping constructs; 2) Poll respondents for attributes that characterize the similarities and differences of those food grouping constructs; 3) Scale, at the ratio level, respondents' perceptions of direct inter-construct differences, as well as construct attributes; 4) Conduct univariate and multivariate t-tests to determine if selected food grouping constructs, grouped together in the Basic Four, are equivalent and; 5) Examine individual attribute comparisons for difference.

Chapter one defined the research problem, presented why it was a problem, told in general what had been done to solve the problem, and stated the objectives of this research. Chapter two will provide a background on Food Grouping Constructs, and investigate attributes associated with the six food grouping constructs of concern.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews the literature in two parts. The first part discusses food grouping constructs from the perspective of food guidance. "Food grouping constructs" and "food grouping concepts" are defined. Constructs of the Basic Four Food Groups are discussed along with the assumptions underlying their creation in 1957. Basic Four food grouping constructs are contrasted with those of the EFNEP Food Planner. The Planner's constructs reflect the differences tested by the hypotheses. The second part of Chapter two reviews evidence for the existence of the six constructs tested in the hypotheses. This review shows how foods and food grouping constructs have been characterized through past research.

Food Grouping Constructs

Since the beginnings of food or dietary guidance in this country (Atwater, 1894), nutritionists have based food groupings primarily on nutrient composition and untested perceptions of what would be simple for consumers to understand. A food group is defined here in two ways, and later operationalized into a third. In the general sense, a food group is a collection of foods that represent some property of meaning to the grouper.

In the nutrition education sense, a food group is represented as a collection of foods that are interpreted by nutrition scientists to be roughly equivalent to each other in composition relative to key (Page et al., 1957) or index[1] nutrients (Jenkins and Guthrie, 1984). These are both **Food Grouping Constructs** because they are groups created for special educational or scientific purposes. **Food Grouping Concepts** are defined here as how consumers themselves would group foods. It is possible for some food grouping constructs to be the same as food grouping concepts. Consumers might group certain foods and call them "Vegetables." Scientists may use "Vegetables" as a construct to be used as stimuli in an experiment.

Consumers have been exposed to guides ranging from four to ten food groups over the last sixty-five years (Hertzler & Anderson, 1974). As few as two groups (Hayes et al., 1955) have been suggested. This variability may be due to the lack of scientific guideposts as to how consumers themselves group foods. Food guide developers continue to create groups on what they think might be easy for consumers to understand rather than on the basis of scientific evidence. The question remains, how do people classify their foods (Sims and Light, 1980)?

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1 Key nutrients, index nutrients, leader nutrients, or indicator nutrients refer to nutrients that serve as guideposts for food consumption. That is, if one ingests the recommended amount of key nutrients through a wide variety of foods, it is likely that the intake of all other nutrients will be sufficient to meet the body's needs. The original eight key nutrients are protein, calcium, iron, vitamin A, thiamine, riboflavin, niacin, and vitamin C (Page & Phipard, 1957).

The Four Food Groups of the Daily Food Guide were devised to provide consumers with conceptual building blocks for meal planning (Page and Phipard, 1957). Foods within groups were supposed to have certain nutrients in common and therefore considered relatively interchangeable[1] in meal planning (Page and Phipard, 1957). Information used to determine food group membership was nutritive composition of foods, food consumption practices, nutritional and dietary status of the population, dietary standards, food availability, and food costs (Light and Cronin, 1981).

The USDA currently uses five food groups in the Daily Food Guide (Anonymous, 1979), the Basic Four plus a "Fats, Sweets, and Alcohol" group. The Basic Four was originally developed for nutrition teachers as "a simple means of translating what is known about the composition of foods into a workable plan that will help the ordinary person select the kinds and amounts of foods that will give a nutritionally good diet" (Phipard & Page, 1962). So as food guidance, the Basic Four was intended to provide two kinds of information to lay persons, information on nutrient composition and meal planning.

Since 1957, the Basic Four Food Groups have served as the cornerstone of public nutrition education efforts in the United States. They

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1 Page and Phipard (1957), the authors of the Basic Four Food Groups recognized that, although foods within each group were much alike in food value, they varied in the amounts of nutrients provided by a serving. Consequently foods with higher amounts of the key nutrients were promoted for consumption.

are the government's official food grouping system[1] for over 230 million Americans. They have been disseminated nationally to individuals, taught to young children through the public school systems, used as educational tools by dietitians and nutrition counselors, and taught systematically through large government programs like the EFNEP.

The Basic Four Food Groups were based on explicit and implicit assumptions of what nutrient based food groups would be "easy to use." There is no evidence to suggest that they were based on scientific investigations of how people themselves grouped foods or how they used foods in meal planning. The developers of the Basic Four never claimed to have based their groupings on a scientific investigation of consumer perceptions. Their "easy to use" claim, however, was never demonstrated. Since these same groupings are still in use today and new food guides are being introduced, the basis for Basic Four groupings needs to be reexamined.

The rationale for limiting the "protective" foods to four groups was that "the number of food groups will influence its ease of use" (Page and Phipard, 1957). The "protective foods" (Hayes et al., 1955; Anonymous, 1981; Light and Cronin, 1981; Guthrie, 1982) of the Basic Four have remained the same for the last 30 years.

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1 The USDA also distributes A Pattern For Daily Food Choices (Anonymous, 1986). This food guidance system is imbedded within one of seven modules that elaborate on recommendations of the Dietary Guidelines. It is not distributed as a stand alone mini poster, and has only been available since 1986.

Authors of the The Basic Four (Page et al., 1957) based its structural design on food composition patterns and the following assumptions (paraphrased in *italics*):

1) *The guide would have greater acceptance if it was in keeping with familiar dietary patterns or food habits and food supplies.*

2) *Simplicity, defined as how "easy" the guide was to use, was "achieved" by limiting the number of groups to four.*

"Easy" and "achieved" were not operationally defined or tested. It was thought that a guide with fewer than four food groups would cause the diet to fall short of some essential nutrients and a guide with more than four groups would be too hard to remember.

3) *Fruits and vegetables could be used interchangeably in meals since both contained vitamins A and C. The inclusion of fruits and vegetables in the same food group "seemed simple" based on this nutrient consideration.*

While this configuration may have appeared simple from the nutritionists' standpoint, the consumers' view remained uninvestigated. Simplicity has been a major argument for the continued use of the Basic Four concept. There has been no evidence, however, to suggest that consumers perceived then or perceive now "Fruits" and "Vegetables" as similar. Nutritional similarity was the only basis given for the assumption that it would be easy to learn the "Vegetable-Fruit" group.

4) *Names for food groups should be derived from a representative food of each perspective group rather than from group related nutrient concepts.* Examples of representative foods include "Meats", "Milk", and "Breads".

Examples of nutrition concepts include "Protein Foods", "Energy Foods", "Protective Foods", and "Vitamin C Foods". It was the opinion of the Basic Four authors that people think about foods more in terms of how they are experienced in markets and meal planning rather than in what nutritional properties they possess (Page and Phipard, 1957).

No rationale, beyond nutrient composition, was given for the inclusion of dried beans, peas, and nuts in the "Meat" Group. Beans, peas, and nuts, however, were distinguished within the "Meat" group as "Meat Alternates". There is no evidence to support or refute the assumption that consumers themselves group foods in this way.

As can be observed from these assumptions, the Basic Four was based on opinion or nutritional considerations, not on evidence about how consumers themselves would group the foods.

Several food guidance systems were developed in response to criticisms of the Basic Four design and/or to incorporate recommendations of the Dietary Guidelines (Anonymous, 1985b). They include the CSPI's New American Eating Guide (Kahn & Hausman, 1979); Handy Five Food Guide (Dodds, 1981); the Reverse Pyramid (Pennington, 1981; Rivers and Collins, 1984); the Red Cross Food Wheel (Anonymous, 1982; Anonymous, 1985a) and the USDA's own A Pattern for Daily Food Choices (Anonymous, 1986). The problem remains, that these guides, like the Basic Four, are not based formatively on consumers' understanding of foods & food groupings. No evidence could be found to show that these food guidance systems match conceptions of consumers any better or worse than the Basic Four. None

bases instructional designs on a scientific assessment of receiver predispositions or usability.

The EFNEP Food Planner (Kallas, 1984; Anonymous, 1985c) evolved from the Daily Food Guide (Anonymous, 1979) but differs in several important ways (Figure 1). The Food Planner was organized into a staggered block pattern where individual blocks, representing food types, were lined up in such a way that they present additional information by their location in the pattern. The Planner was based on six "types" of foods separated by "Plant" and "Animal" sources. "Types" of foods are not synonymous with food groups.[1]

The EFNEP Food Planner pictorially distinguishes between the following food construct pairs[2] and visually separates plant and animal sources. Representative foods are illustrated within a boxed off location for each type. In contrast, these pairings are grouped together in the Daily Food Guide:

1. "Fruits" and "Vegetables"
2. "Meat, Poultry, Fish, Eggs" and "Beans"
3. "Animal" and "Plant" sources of foods

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1 Food groups are arranged so that each has its own recommended servings. While types mimic groups, each group has a separate and unique recommendation, different "types" may share the same recommendation. For instance, "Meats" and "Beans" may represent two types of foods, but servings can be taken from either one to satisfy a protein recommendation.

2 Not all food grouping constructs are represented here. "Bread—Cereal" and "Milk—Cheese" groups are not the subjects of this dissertation.

Developers of the Planner (Kallas, 1984) think that "Fruits" and "Vegetables", "Meats" and "Beans", and "Animal" and "Plant" sources of foods are viewed as conceptually different[1] by EFNEP participants. Each food group pair was said to differ in food role expectations, food preparation, and other attributes.

Food role expectations are those where foods are expected, by habit or design, to serve a distinct role in the diet; like "Fruits" as snacks, and "Vegetables" as side dishes. Lewin (1943) called these meal patterns. They are also known as foodways (Gifft et al., 1972). Other attributes associated with foods could be sensory, life-style, preference, or composition related.

If these foodway distinctions are really made by consumers, then the Basic Four and guides based on its design may not be interpreted by audiences in the way anticipated. Consequently, assumptions regarding the Basic Four's simplicity would be in question. Neither the Daily Food Guide (based on the Basic Four) nor the EFNEP Food Planner has undergone

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1 The EFNEP Food Planner is not the only food guidance system to separate foods grouped in the Basic Four. Reasons for separations in other systems were, however, rarely due to perceptual considerations. "Fruits" and "Vegetables" have been made separate and distinct by the proposed Handy Five Food Guide (Dodds, 1981); the Red Cross Food Wheel (Anonymous, 1982; Anonymous, 1985b) and the USDA's own A Pattern for Daily Food Choices (Anonymous, 1986). "Meats" and "Beans" were separated by the proposed Food Pyramid (Anderson, 1977) and the proposed Handy Five Food Guide (Dodds, 1981). The suggestion to create a separate "Bean" group was also made by Axelson et al. (1986) and King et al. (1978). Foods from "Animals" and "Plants" were separated and distinct in the proposed Handy Five Food Guide (Dodds, 1981).

scientific scrutiny to test these contrasting conceptions with consumers. The apparent discrepancy in assumptions between the Daily Food Guide and the EFNEP Food Planner, has served as one instigation for the research presented here.

In this section food grouping constructs have been defined and their purpose within traditional American food guidance has been delineated. Currently used constructs were discussed along with the assumptions underlying their original creation in 1957. The EFNEP Food Planner was discussed in more detail because it represented differences outlined in the research problem and was part of the motivation for testing the hypotheses. Unlike the other alternatives to the Basic Four, the Planner is now being widely distributed to consumers.

Evidence for Constructs

This section reviews the literature on the characterization of food grouping constructs by ratings of individual foods likely to represent those constructs. Individual foods were not assumed to represent groups exactly; they are just individual members of groups. Research that directly characterized food grouping constructs was not found. An example of a direct characterization would be: "How sweet are Fruits?" An indirect characterization would focus on individual foods and ask, for instance: "How sweet are apples?" The utility of reviewing the characterization of individual foods will not be known until further research is done. Studies that characterized foods did so using two data analytic techniques; they were

factor analysis and more recently multidimensional scaling. A general discussion of each method precedes those studies that used each method.

Factor analysis and multidimensional scaling are data analytic techniques used to find patterns underlying sets of variables (Green and Carroll, 1978). Brief descriptions of these techniques are provided to help clarify literature cited here. These techniques were not used to test the hypotheses of this dissertation for reasons given later. They merely provide a framework within which to interpret studies reviewed.

Factor analysis represents a class of data analytic techniques used when a researcher is interested in mapping a set of interdependent relationships. The goal of factor analysis is to summarize data into a smaller set of linear composites (factors) that explain as much of the variance as possible. Factor analysis assumes that observed variables are linear combinations of so-called underlying factors. Observed variables usually consist of ratings of objects (like foods) according to attributes (like "sweet"). Factor loadings are outcomes of factor analysis. Factor loadings represent the correlation of a particular variable with a factor. As correlations, factor loading values range from zero to one. A "high" factor loading is signified as 0.5 or higher in absolute value. (Green and Carroll, 1978)

Factors themselves represent linear composites of intercorrelated variables. Linear composites are constrained to orthogonality. Factors are orthogonal when they are at right angles (uncorrelated). If it were found that observed variables were highly intercorrelated over repeated measurement occasions, an attempt might be made to develop a "construct". "This would entail the establishment of additional observable variables, subsequent

testing, and so on" (Green and Tull, 1978). One factor analytic study is not enough to establish the reliable existence of an underlying variable. The more developed a construct, that is, the more tests confirming the existence of a factor's underlying variable, the greater the inferential power for studies using that variable.

Principle components factor analysis (Green and Tull, 1978) was used by several nutrition researchers (Table 1) to investigate foods and food related attributes. Principle components factor analysis maximizes the variance of variable projections on each axis. All factors are constrained to orthogonality. This assumes that underlying factors are unrelated. No theoretical reason has been found to explain why or how factors that describe foods and their interrelationships are unrelated (orthogonal) in human experience. Therefore factors may represent high intercorrelations between variables or artifacts (orthogonal variance) of the factoring method.

The studies reviewed (Table 1) were first-run factor analytic explorations. Confirmatory factor analyses were not run to test hypotheses. Exploratory results provide only indications of underlying factors that might be investigated further as constructs. The results from studies cited in the literature review were not confirmatory nor were there attempts by researchers to develop "constructs" from factors. Consequently, results of past research were considered only as information on which to build testable hypotheses.

Labels attached to factors are invented by researchers and have no magical truth or meaning. They reflect the thinking of the labeler. Some may

make more intuitive sense to the reader than others. Labels provided by authors were used in the literature review for the sake of discussion.

Pilgrim & Kamen (1959) studied patterns of food preferences through factor analysis. They measured soldiers' preferences for 54 different foods using a 9-category like-dislike rating scale. Factor analyses were conducted on these ratings for two random samples of 200 soldiers each. A ten factor solution was found for each sample. The authors concluded that factors arose not only from sensations from the foods but from some cultural or environmental determinants as well. Factors accounting for the most variance in the combined[1] results were:

1) "Sweet", associated with dessert foods.

2) "Meat-Solid", associated with main dish foods.

3) "Fruits", associated with healthful foods.

4) "Strong flavors", associated with vegetables.

Factor labels were based on interpretations of a panel of "experts" composed of one nutritionist, and six psychologists working in the area of food acceptance. Labels were derived independently and finalized in group discussion.

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1 The "most variance" was calculated by combining the variance accounted for (sums of squares of factor loadings) for a factor (e.g., Meat-solid) from the first survey to the variance accounted for, from the corresponding factor (e.g., Meat-solid) of the second survey. This provided a single cumulative solution with the four factors above.

Table 1. STUDIES INVESTIGATING PERCEPTIONS OF FOODS
Eight studies are shown that investigated the underlying meaning of foods using factor analysis or multidimensional scaling (MDS). All but three* are covered in detail in the text. All factor analytic studies below used principle components analysis.

AUTHORS	RESPONDENTS	MEASURED	SCALE	ANALYSIS
PILGRIM KAMEN 1959	400 SOLDIERS MALES	PREFERENCE 54 FOODS	9-PT ORDINAL	FACTOR ANALYSIS
SCHUTZ RUCKER HUNT 1972	30 PATIENTS 26 STAFF HOSPITAL	APPROPRIATENESS 12 FOODS	5-PT ORDINAL	FACTOR ANALYSIS MEAN APPROPRIATENESS
JELLINEK 1973 *	166 TEENS	FLAVORS/ TEXTURES 8 SNACK FOODS	7-PT ORDINAL SEMANTIC DIFFERENTIAL	FACTOR ANALYSIS
FEWSTER BOSTIAN POWERS 1973 *	100 HOMEMAKERS FEMALES	MEANINGS 5 FOODS 3 FOOD GROUPS	7-PT ORDINAL SEMANTIC DIFFERENTIAL	FACTOR ANALYSIS
SCHUTZ RUCKER RUSSELL 1975	200 HOMEMAKERS FEMALES	APPROPRIATENESS 56 FOODS	7-PT ORDINAL	FACTOR ANALYSIS MEAN APPROPRIATENESS
MICHELA CONTENTO 1984	115 CHILDREN 5-11 YR OLDS	NUTRIENTS 23 FOODS 71 FOOD PICTURES	4-PT ORDINAL SORTED	MEANS REGRESSED ON MDS MDS CLUSTER ANALYSIS
DALTON LINKE SIMKO 1986 *	202 CORPORATE EMPLOYEES AT WORKSITE	FOOD CHOICES PRE-POST ANALYSIS	5-PT ORDINAL LIKERT	FACTOR ANALYSIS
AXELSON KURINIJ BRINBERG 1986	51 COLLEGE STUDENTS 79% F / 21% M	SIM-DISSIMILAR 23 FOODS ATTRIBUTES	11-PT ORDINAL 11-PT ORDINAL	MDS REGRESSED ON MDS

Evidence existed for underlying "Meat", "Vegetable", and "Fruit" factors. Meat items loaded high on a factor labeled "meat-solid" and was associated with the terms main dish, beef-eater, and masculine. One factor, found only in the second survey, was labeled "mixed meat" and was also associated with "main dish". Vegetable items loaded high on factor four, the "strong flavors" factor. Fruit items loaded high on factor three which was labeled the "Fruit" factor. It was associated with healthful and youth. Preference, defined as a 9-point continuum of like to dislike, was found associated with fruits, but crossed irregularly through other food classes. This is now a thirty-year-old study of army soldiers who were fed army food. It is difficult to say how their perceptions relate to consumers today. At best, consistencies will be revealed with later studies whose respondents also distinguish foods associated with "Meats", "Fruits" and "Vegetables".

The strengths of these studies were relatively large sample sizes (200 each) and in the similarities between the two factor solutions. Five of the 10 factors in each study were the same. These duplicate findings indicated some reliability for those five factors. This was the first study found to empirically investigate perceptions of individual foods using factor analysis. Pilgrim and Kamen (1959) demonstrated the utility of factor analysis as a tool for studying food preferences. The present research is concerned with 1980's consumers in general. Pilgrim and Kamen's study (1959) was conducted almost 30 years ago. The sample was composed of enlisted men accustomed to eating 1950's regulation army food. The study involved individual foods, not food groups. It is difficult to determine the influence of these sample considerations on perceptual dispositions.

Schutz et al. (1972), studied reactions to food-use combinations using appropriateness[1] ratings and factor analysis. In this study, patients and employees of a hospital were asked to judge the appropriateness of 12 foods for 12 different uses (e.g., for lunch, for dinner, "when I want something nutritious") on a five point appropriate (1) to inappropriate (5) scale. Two subsamples provided appropriateness ratings for the 144 possible food-by-use combinations. The first involved 30 hospital patients, the second involved 26 staff members. Mean appropriateness ratings were calculated and factor analyzed. Three factors accounting for a total of 98 percent of the variance were:

1) "Healthy dinner", associated with salads, vegetables, and roast beef.
2) "Seldom appropriate in given situations", associated with fried eggs, tacos, and hamburger.
3) "High calorie treat", associated with wine, tacos, and ice cream.

Results related specifically to food grouping constructs or food related attributes are reported here. Since groups were not the unit of study individual food results will be reported. Roast beef represented the "Meats" group, "Vegetables" were represented by their group label "Vegetables", and canned fruit represented the "Fruits" group. The rating scale used spanned 5 categories from appropriate to inappropriate. For the purposes of this review, a decision rule was made to transform those 5 categories into 3;

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1 Appropriateness was not defined and was understood to represent conventional language with no special scientific referent.

appropriate, neutral, and inappropriate. Food-use combinations were considered appropriate here if the mean value was ≤ 2, neutral if the mean value was between 2 and 4, and inappropriate if the mean value was ≥ 4 on the 5-point scale. Middle values (those between 2 and 4) were relegated to neutral status to bring focus to the more extremely held food-use appropriateness ratings. That is, to focus on those ratings closest to 1 (appropriate) and 5 (inappropriate).

Roast beef was reported by patients to be appropriate for lunch, dinner, special holidays, to lose weight and for something nutritious, and inappropriate for breakfast, the evening snack, and before going to sleep. Staff members reported the same appropriateness levels for all patient food-uses except for nutritious, which fell into the neutral category.

"Vegetables" were reported by patients to be appropriate for lunch, dinner, special holidays, to lose weight and for something nutritious, and inappropriate for breakfast, the evening snack, and before going to sleep. Staff responses were the same with one exception; "Vegetables" fell in the neutral category for the evening snack.

Canned Fruit was reported by patients to be appropriate for breakfast, lunch, dinner, the evening snack, when not very hungry, and for something nutritious. "Canned Fruit was not inappropriate for any use according to this group. Staff responses differed only in that Canned Fruit was neutral for dinner.

Roast beef, according to the above characterizations, was reported to have very specific uses. Hamburger, on the other hand, was not found appropriate nor inappropriate for any food-uses. It was a neutral food. This

may signify hamburger as a more flexible food that does not necessarily fit, but can fit, into many situations. "Vegetables" were more similar to roast beef than they were to Canned Fruit. This can be explained for two possible reasons. First, both Roast Beef and "Vegetables" were reported as inappropriate for breakfast and evening snacks while Canned Fruits were appropriate for these uses. Second, canned fruits may differ from "fresh" fruits in desirability. This desirability difference may be particularly true for certain situations like holidays or being in the hospital. Canned fruits are often sweetened and may represent extra calories. They may also represent the distained kind of prepackaged foods often served in hospitals. In conclusion, appropriateness similarities existed between "Vegetables" and Canned Fruit concerning lunch, dinner, and nutritious food uses. Appropriateness differences existed, however, to a great extent for evening snacking, and breakfast, and to a moderate extent for holidays, to lose weight, and before going to sleep. The hospital staff did not differ much from patients in their perceptions. Perhaps this could be expected to a certain extent in a hospital setting.

One strength of this study is that all 144 appropriateness values were reported which allowed for independent examinations of results. Another strength is that they expanded the study of perceptions to indicators of appropriateness. Appropriateness of food-use combinations might provide indicators of foodways that may generalize to food grouping constructs. Limitations of this research included its small sample sizes and highly specialized hospital context. Patients are generally restricted to diets provided by hospitals. Participants of this study may have reacted to what

was appropriate for hospital food rather than for eating situations of everyday life. The other sample (the staff) was composed of nurses and dietitians. Their health training and the fact that the survey was conducted in their professional environment may have affected their responses on the questionnaire. Another limitation is that while stimuli were listed in order of the magnitude of their factor loadings, Schutz et al. (1972) did not publish the actual factor loadings. It is impossible to guess how many of the factor loadings listed (even though they are listed in order) were high on any of the three dimensions. Consequently, stimuli factor loadings were considered uninterpretable and therefore not reported in this review. Schutz and co-workers (1972) studied individual foods, not food groups, the focus of this dissertation. The five-point ordinal scale they used does not allow a proportionate understanding of exactly how appropriate foods are in relation to other foods. A ratio scale would have allowed a direct proportional comparison of different foods for specific food uses. For example, one might have asked, "how much more appropriate are "Vegetables" than "Fruits" for dinner?" Both may have been scaled as appropriate (1), but "Vegetables" may be four times more appropriate than "Fruits". The ratio scale, which would provide this information, is discussed in the methods section.

Schutz et al. (1975), studied food and food use classification systems. Their sample included two hundred respondents, fifty from each of four major metropolitan areas: Los Angeles, Chicago, Atlanta, and Boston. They were primarily white, well-educated, middle-class housewives between the ages of 25 to 55. Respondents were asked to rate the appropriateness of 56 foods

by 48 food uses. Ratings were based on a seven point scale ranging from 1, never appropriate, to 7, always appropriate. Mean appropriateness ratings were factor analyzed resulting in a five factor food classification solution. Factor analysis results follow. Information is given in this sequence: The factor label, the proportion of variance accounted for by that factor (in parentheses), and then examples of foods loading highly on that factor. Schutz et al. (1975), only included stimuli responses with factor loadings ≥ 0.50.

Table 2. SCHUTZ & CO-WORKERS (1975) 5 FACTOR SOLUTION

A five factor solution of 200 female respondents who rated 56 foods by 48 food uses. Food grouping constructs of importance to this literature review are in bold print.

FACTORS	VARIANCE ACCOUNTED FOR
1) High calorie treat Wine, pie, cake, soft drinks.	(0.13).
2) Specialty meal items **Meats** (liver, meat loaf, fish) **Beans**/Broccoli (baked bean, peas, broccoli)	(0.23).
3) Common meal items **Meats** (chicken, roast beef, steak, ham hamburger) **Vegetables** (tossed salad, tomatoes, carrots)	(0.19).
4) Refreshing healthy foods **Fruits** (orange juice, strawberries, apples watermelon) Dairy products (cottage cheese, milk, yogurt, ice cream)	(0.15).
5) Inexpensive filling foods Peanut butter, bread, Am. cheese, potato chips, pickles	(0.10).

It appears that two recognizable patterns occur together in this factor space. The first represents common eating situations like meal patterns. This can be seen by the meal-type labels of each factor. The second pattern represents food grouping constructs like "Meats" or "Vegetables". Foods from particular food groups are perceived to be associated with particular eating situations. In some cases, as with fruits and dairy products of factor 4, more than one food group could be suitable for a particular situation.

Factor analysis provided clear evidence that "Fruits" and "Vegetables" were perceived as distinct and different in food usage. "Fruits" and "Vegetables" were found on different factors with little covariance. Out of four fruits included in the analysis, none, with factor loadings over 0.50, were found on factors two or three with "Vegetables". Out of nine "Vegetables" included in the analysis, only one, vegetable soup, was found on factor four along with "Fruits". Vegetable soup is a mixed food and not typically represented in food guidance.

These factor analytic results (Table 2) did not show a clear difference between "Meats" and "Beans". Beans and peas covary to some degree with certain kinds of "Meats" in factor 2 (Specialty meal items). Liver, meat loaf and fish, from factor 2, are clearly "Meats". The last three "specialty" meats covary with factor three. "Beans" do not covary, to a reportable degree (Factor loading ≥ 0.50), with what are called here, the classic meats of factor 3: steak, roast beef, hamburger, ham, and chicken. It is possible that this factor solution is an accurate reflection of how consumers view foods with respect to food-use appropriateness. It is also possible that factors 2, 3, and 4, are artifacts of orthogonal factoring and not a true representation of high

intercorrelations between variables. Factors 2, 3, and 4, could represent up to six or more non-orthogonal factors. "Fruits", "Dairy Products", "Vegetables", "Meats", "Specialty Meats" and "Beans" may have all represented distinct non-orthogonal factors.

Fifteen out of 56 mean appropriateness ratings were published by Schutz et al. (1975). Consequently only three "Meat" and one "Fruit" ratings are available for reporting here. No "Bean" or "Vegetable" ratings were available for comparison. Only ratings ≤ 2 for "never" appropriate and ≥ 6 for "always" appropriate were reported by Schutz et al. (1975) as potential descriptors for food grouping constructs. "Meats", represented by chicken, roast beef, and steak, were rated as "always" appropriate for dinner, as a main dish, when I eat out and when I'm really hungry. They were also "always" appropriate for classes of people like teenagers, men, guests, and children. Recall that the sample was 200 female homemakers. They themselves appeared to be the only group for which these foods were not "always" appropriate. "Meats" were "never" appropriate for breakfast, dessert, or in a salad. Steak was an exception to the breakfast rating. "Bean" mean appropriateness ratings were not available for comparison. Peanut butter, a food often listed as a "Bean"-type alternate protein source, had mean appropriateness ratings listed. Peanut butter was rated as "always" appropriate for teenagers. It was rated as "never" appropriate for dinner, the main dish, in a salad, for dessert, or when you eat out.

Mean appropriateness ratings for "Fruits" were represented by orange juice. As a liquid, orange juice may differ from, and therefore not be representative of "Fruits". Orange juice was rated as "always" appropriate for

serving cold, in the summer, for children, for teenagers, and for something nutritious. It was rated "never" appropriate for a main dish, a spicy food, in a sandwich, or boiled. "Vegetable" appropriateness ratings were not available for comparison with "Fruits".

To summarize the results of Schutz et al. (1975), a factor analysis of mean appropriateness ratings of foods by eating situations found "Fruits" and "Vegetables" with high loadings on separate factors. "Fruits" were rated appropriate served cold but not as a main dish, a spicy food or boiled. These ratings did not match those of "Vegetables" which were identified as common meal items and are often cooked and spiced. According to the same analysis, "Beans" did not covary appreciably with what could be called the classical "Meats"; chicken, roast beef, and steak. "Beans" do covary, however, with what Schutz et al. (1975) called "specialty meal items": liver, meat loaf, and fish. Foods typically classed as "Meats" were rated as appropriate for the main dish, for dinner, when I eat out, and when I'm hungry. They were not appropriate for dessert, in a salad, or for breakfast unless it was steak for steak and eggs.

Strengths and limitations of this study involved it representativeness to the general population; the sample was reasonably large at 200 and included respondents from 4 geographically dispersed metropolitan areas. Respondents, however, were all female homemakers. Homemakers may have clear opinions about foods because they are more likely to be working with foods and planning meals than other members of the population. They may serve as the perpetuators of foodways and, therefore, may serve as a mirror of the population.

Studies investigating consumers' perceptions of foods have also been conducted using multidimensional scaling. Multidimensional scaling (Torgerson, 1958; Green and Carmone, 1970; Kruskal and Wish, 1978; Woelfel and Fink, 1980; Schiffman et al., 1981) represents a class of procedures concerned with the spatial representation of relationships among objects. These procedures are based on the distance between points or derived proximities[1]. Resulting configurations are said to reflect the "hidden structure" (Kruskal and Wish, 1978) of the data. Multidimensional scaling provides a solution in terms of distances between objects. The closer objects are, the more similar they are. The more distant the objects, the greater the difference between them.

Multidimensional scaling (MDS) differs from factor analysis. In factor analysis the variable space is taken to be representative of the underlying relationships of a set of attributes with respect to a sample of individuals. In multidimensional scaling the object space is analogous to perceptual space (MacCallum, 1974). That is, the inter-point distances correspond to perceived relationships between objects. In factor analysis, stimuli are typically rated against predetermined attributes. With multidimensional scaling, stimuli are rated against themselves. For example, foods are rated against other foods by whatever criteria the respondents themselves use, not against researcher specified attributes.

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1 "Proximities are numbers indicating how similar or different two objects are or are perceived to be." (Kruskal and Wish, 1978).

In multidimensional scaling dimensions represent coordinate systems, not factors. Some researchers, however, label dimensions as if they were factors. Authors of both multidimensional studies cited here, interpreted and labeled axes. They used INDSCAL[1] (Carroll and Chang, 1970; Schiffman et al., 1981) computer programs to conduct multidimensional scaling analyses. INDSCAL uses algorithms that rotate the solution to maximize variance along the axes (Woelfel and Barnett, 1982). This, however, still does not guarantee attribute-dimension equivalence. That is, underlying patterns (attributes) may not fit neatly into orthogonal dimensions for the same reason mentioned for factor analysis. No theoretical reason was found to explain why or how connotative meanings for foods are unrelated (orthogonal) to each other in human experience. Schiffman and co-workers (1981) state that coordinate axes in the stimulus space may not lie in the same directions as perceptual dimensions and that more than one qualitative attribute may describe a single dimension. Woelfel and Barnett (1982) go further and argue that attributes be scaled as points or "monopolies" in the space rather than as linear continua.

> An object is "good", therefore, insofar as it is close to the point "good" in the space, and "bad" insofar as it is close to the point "bad". Such a solution seems inherently superior to the idea that attributes should be represented as line segments, since it leaves open the possibility that an object might increase or decrease the extent to which it manifests any quality without simultaneously increasing the extent to which it manifests the "opposite" quality. Changing the chemical composition of a substance, for example, might increase the extent to

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1 INDSCAL stands for Individual Differences Scaling.

> which it is "sweet" without decreasing the extent to which it is "sour". If such a view is true, then the dimensions of an MDS space need not be substantively interpretable. (Woelfel and Barnett, 1982)

This position is supported by four studies where attributes were scaled along with foods (Worsley et al., 1984a; Worsley et al., 1984b; Worsley et al., 1984c; Worsley et al., 1985). Attributes, like "good-for-you", "sweet", and "fattening" were scaled as proximities and interpreted as inter-point distances along with foods. The closer objects were to sweet, the sweeter they were perceived to be. The more distant the objects were from sweet, the less sweet they were perceived to be. Due to these findings, results from multidimensional studies by Michela and Contento (1984), and Axelson et al. (1986) will be interpreted in terms of inter-point distances as well as author labeled dimensions.

Axelson et al. (1986) conducted an exploratory analysis of twenty-three foods using multidimensional scaling. Their purpose was to examine how respondents themselves would group foods according to proximity data. Fifty-one college students were presented with a questionnaire listing all possible pairs of 23 foods. These foods were selected to represent the Basic Four Food Groups. No combination, or mixed foods[1] were included. An 11 point similar (10) to dissimilar (0) scale was used for the paired comparisons task. Values for each food-by-food cell were averaged and a multidimensional scaling analysis was conducted on a non-redundant half of the averaged matrix. Respondents also rated the 23 foods according to 21

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1 The authors did not consider ice cream, yogurt, doughnuts, bread, or bean soup to be mixed enough to present a problem to respondents.

attributes (including 8 nutrients) on an 11-point scale. This was done to provide information as to what basis respondents made similarity judgments. The 23 food location coordinates from the multidimensional solution were then regressed onto the 23 food mean scores for each food-attribute rating to determine which attributes were associated with which dimensions.

Using multidimensional scaling, Axelson et al. (1986) generated a three dimensional solution from the data. (Figure 2) These were the dimension labels:

1. "Convenient" vs "Inconvenient" foods.
2. "Bad" versus "Good".
3. "Animal" vs "Plant".

An examination of Figure 2 reveals possible food grouping patterns in the data. With the exception of peanut butter, all foods located at the top of the vertical dimension are from "Animals" and all foods at the bottom from "Plants". Dimension 3 was labeled "Animal" - "Plant" by Axelson and co-workers. This configuration of points support the contention that consumers (students in this case) made perceptual distinctions between foods from "Animal" and "Plants". Foods from "Animals" and "Plants" covaried across the other two dimensions.

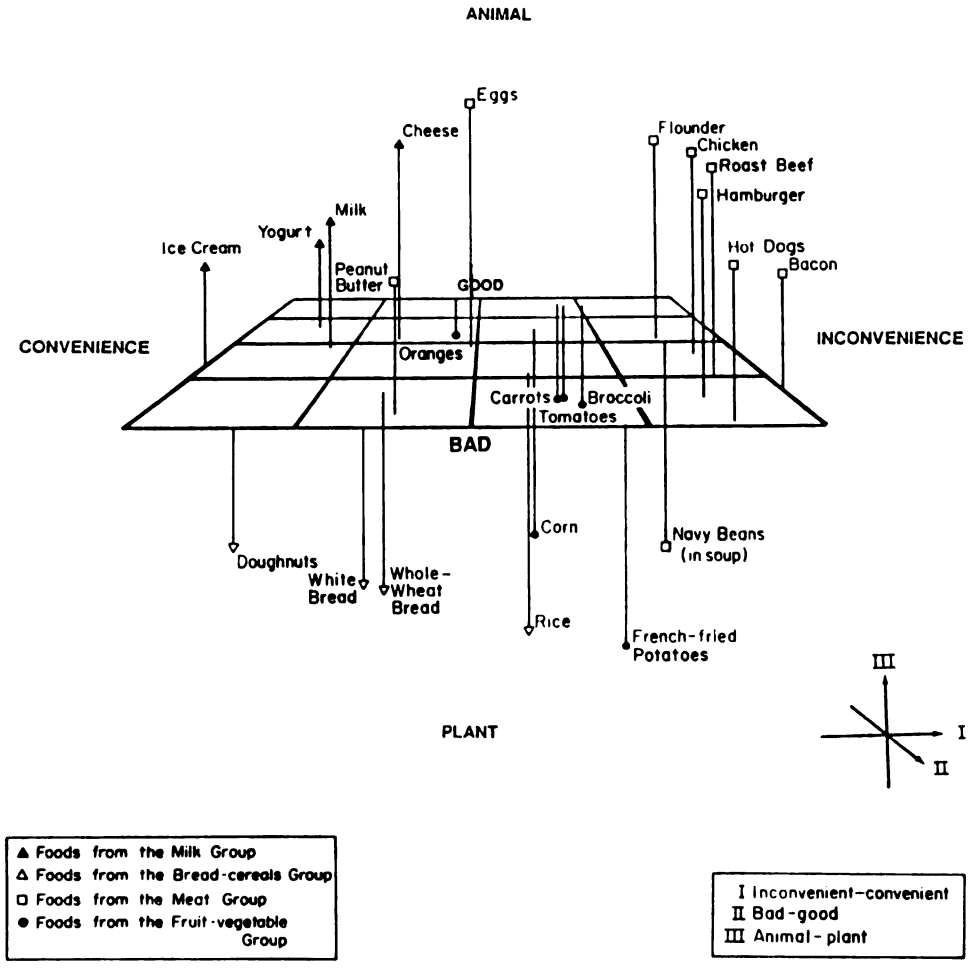

Figure 2. Axelson's Multidimensional Scaling Analysis of 23 Foods
A three dimensional plot of 23 foods by fifty-one college students displays a potential "Animal-Plant" dimension on the vertical axis.

Adapted from Axelson, Marta L., Kurinij, Natalie, and Brinberg, David:
An analysis of the four food groups using multidimensional scaling.
Journal of Nutrition Education, **18**: 265-273, 1986.

"Meats" and Navy "Beans" are relatively distant from each other along the "Animal" - "Plant" dimension. "Meats" appear to be clustered as a group in the upper-right quadrant of the multidimensional space. This cluster spreads out along the second dimension going into the paper. That second dimension is labeled "Bad" (towards you) to "Good" (away from you). Along the convenience dimension (left to right) "Beans" do not appear different from "Meats". Navy "Beans" are close to flounder along "convenience" and "good-bad" dimensions. This would be in agreement with the findings by Schutz et al. (1975) where baked "Beans" were associated with fish, a specialty "Meat".

These findings (Axelson et al., 1986) support the existence of a perceptual difference between "Meats" and "Beans" along the "Animal" - "Plant" dimension. Axelson and co-workers (1986) recognized differences to be so great between "Meats" and "Beans" as to suggest the creation of a legume group. Limitations of this study were that only one "Bean" and one "Fruit" representative were included in the analysis. The "Fruit" was the orange and the "Bean" was bean soup.

"Oranges" differed from "Vegetables" (carrots, tomatoes, corn, and broccoli) primarily along the convenience dimension. But relative differences are not that great. Foods at the end of dimension two (into the paper near oranges) are associated with the following attributes: Good for your health, low in calories, and high in vitamins and fiber. These attributes describe both "Fruits" and "Vegetables".

Peanut butter, often considered by nutritionists as a meat alternate, is on the "Animal" end of the 3rd dimension. Schutz et al. (1975), also found peanut butter to be different from other "Beans". Axelson et al. (1986), and

Schutz et al. (1975) found peanut butter relatively different from both "Meats" and "Beans" on all reported dimensions, therefore, peanut butter may define its own category.

One benefit of using multidimensional scaling is that it is less subject to experimenter contamination (Schiffman et al., 1981) than factor analytic procedures. That is because multidimensional scaling does not require a list of attributes by which to judge stimuli. This allows respondents to react directly in response to stimulus foods and not to a list of attributes, which may or may not be relevant to respondents. The result is that the perceptual space is probably more representative of the respondents' own underlying structure than it would be if attributes were interfering. As was said earlier, however, Axelson et al. (1986) scaled and then regressed 21 attributes with stimulus food coordinates. If attributes were selected without input from the respondents, the researcher runs the risk of describing the output in a way inconsistent with respondents. If the goal is to classify foods in the way the respondents themselves would do it, as Axelson and co-workers (1986) suggest, then it seems appropriate to use natural language terms generated from respondents themselves. Otherwise, researcher-based attributes become the defacto descriptors of the space. If one scaled 23 foods by a "good food for goats" attribute, you will get responses and be able to regress coordinate values on those responses. A "good food for goats" attribute may actually be explainable in the space, but it will not reflect how respondents themselves would explain it.

Michela and Contento (1984) conducted a multidimensional scaling analysis of the spontaneous classification of foods by 115 children aged 5 - 11. Children were given 71 pictures of foods and asked to place them into groups that were alike in some way or should be in the same group for any reason. Food stimulus pictures included more diversity than those used by Axelson et al., (1986). Food pictures included, for example, mixed foods[1], candy, and beverages.

In the sorting process, respondents placed foods into "Meat" (61%), "Fruit" (44%), and "Vegetable" (43%) groups. No "Beans" group was formed. Twice as many respondents placed "Vegetables" and "Fruits" apart (43-44%) as together (22%). It is likely that since this study was conducted in the public schools at the elementary level, students had probably been exposed to the Basic Four Food Groups in their health lessons. Also the children were asked to put foods into "groups" as opposed to pockets or piles. This task could have represented a test of recall for some of the students. In the school setting it was not surprising that the number of students placing "Vegetables" and "Fruits" together was as high as it was at 22%.

Michela and Contento (1984), conducted two cluster analyses on derived proximities values. This resulted in 4 and 8 group clusters. The four group clusters did not resemble the Basic Four Food Groups nor did it reflect any of the 9 natural groupings generated from the sorting process. Consequently the 8 cluster solution was preferred for this discussion. Three of the eight clusters were: "Fruits", "Vegetables-Potatoes-Beans", and "Meat-

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1 Mixed foods are combination foods. That is, they are made up from foods from more than one food group.

Fish". Again, "Fruits" and "Vegetables" , as well as "Meats" and "Beans" were in different groupings. "Beans", however, did not have a cluster of their own; they were found clustered with "Vegetables".

Michela and Contento (1984) completed a food by food matrix of co-occurrences from the sorting task data. Every time two foods were put in the same group, a "1" was put in their column-row spot in the matrix. Values for each cell were averaged and a multidimensional scaling analysis was conducted on a non-redundant half of the averaged matrix. Only 44 of the 71 original foods were used in the multidimensional analysis due to limitations of the INDSCAL program. Data from twenty-seven foods judged to be highly similar were removed. A four dimensional solution was generated from the data. Dimensions one through four were labeled:

1. Sweet vs nonsweet foods. (Figures 3)
2. Meal entrees versus more versatile foods and drinks. (Figures 3)
3. Whole, fresh, less processed vs cooked, more processed. (Figure 4)
4. Animal vs plant. (Figure 4)

"Meats" and "Beans" show the most difference along dimension 4, where "Meats" are associated with the "Animal" region near the bottom-left of Figure 4 and "Beans" are associated with the "Plant" region near the top-right quadrant. Dimension 2 is labeled Meal entrees (bottom-left) vs More versatile foods and drinks (spanning upper-left to middle-right). "Meats" and "Beans" are different along this continuum as well. "Meats" appear to represent meal entrees. Vertically up dimension 2 are some mixed dish entrees (tacos, spaghetti), side dishes (soup, salad) and then vegetables,

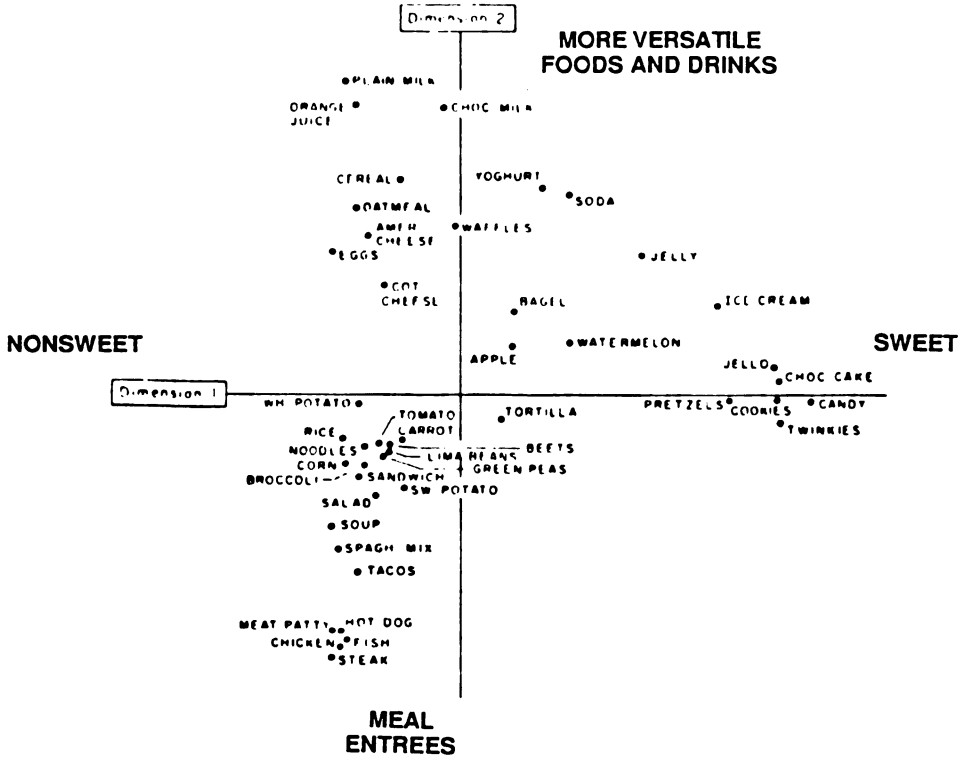

Figure 3. Michela & Contento's MDS Analysis: A
A multidimensional scaling analysis of 44 foods by 115, 5-11 year olds. Dimension 1 was labeled Nonsweet (left) to Sweet (right). Dimension 2 was labeled Meal entrees (bottom) to more Versatile foods and drinks (top). Clusters are apparent for "Meats" and "Vegetables"

Adapted from Michela, J.L. and Contento, I.R.:
Spontaneous classification of foods by elementary school-aged children.
Health Education Quarterly, **11**: 57-76, 1984.

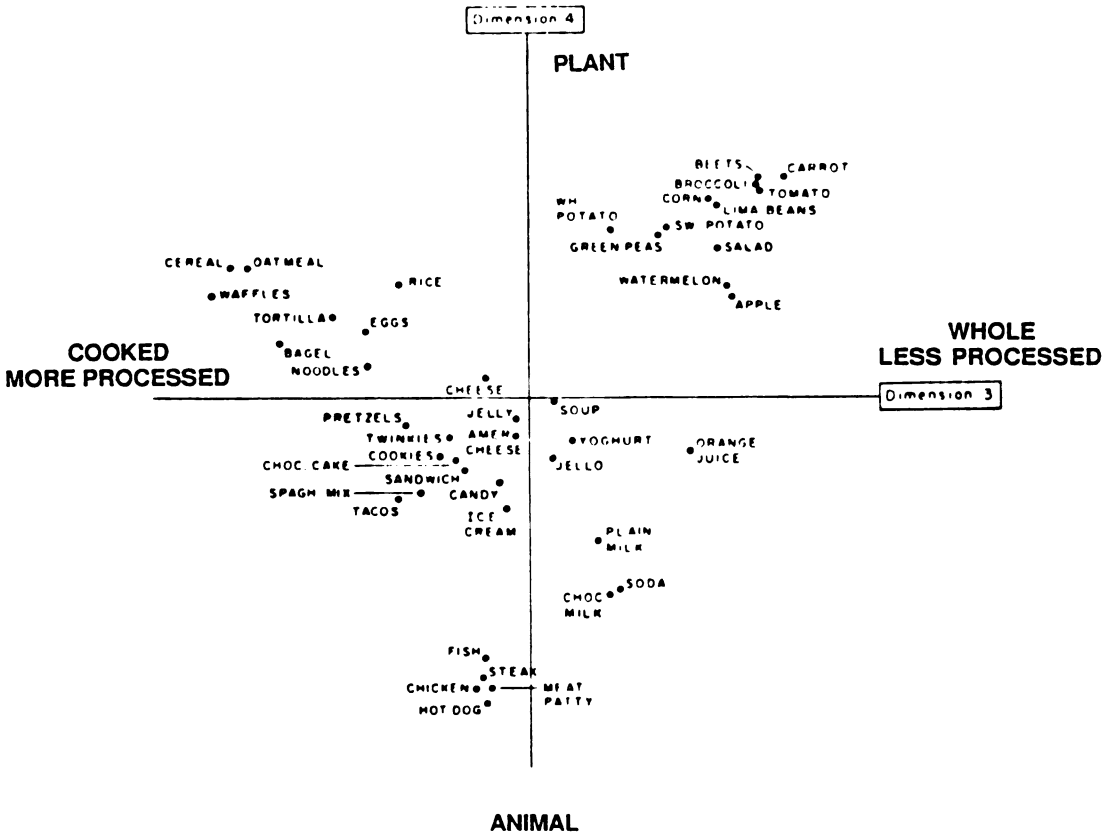

Figure 4. Michela & Contento's MDS Analysis: B
A multidimensional scaling analysis of 44 foods by 115, 5-11 year olds.
Dimension 3 was labeled more Processed (left) to less Processed (right).
Dimension 4 was labeled Plants (top) to Animals (top).
Clusters are apparent for "Meats", "Vegetables", and possibly "Fruits".

Adapted from Michela, J.L. and Contento, I.R.:
Spontaneous classification of foods by elementary school-aged children.
Health Education Quarterly, **11**: 57-76, 1984.

including beans. "Meat" and "Bean" representatives are tightly clustered at their own locations in the space. "Meats" and "Beans" do not appear to be different in sweetness and only slightly different along the processing dimension, 4.

"Fruits and "Vegetables" show marginal differences across all dimensions. The greatest differences are found along dimension 2. "Vegetables" are closer to meal entrees than "Fruits". Another observation is that "Vegetables" are clustered while fruits were spread throughout the top of Figure 3 in the more versatile foods area.

Dimension 4, the "Plant"-"Animal" continuum, provides evidence that consumers make "Plant"-"Animal" distinctions even though they were not overtly articulated by respondents. In contrast to the multidimensional scaling analysis, none of the food categories directly formed by respondents or their explanations of why foods were put into certain groups revealed overt "Plant"-"Animal" distinctions. Both this (Michela and Contento, 1984) and the Axelson et al. (1986) study, demonstrated a "Plant"-"Animal" dimension.

The Michela and Contento (1984) study included further evidence for differences between all three pairs of food grouping constructs. It, however, used a sample of 5 to 11 year olds who were responding to questions in the context of school. This raises questions regarding the generalizability of results from this sample to consumers in general. The generalizability will depend on similar findings from other studies using different age groups. One contribution made by Michela and Contento (1984) was the use of cluster analysis to determine group membership of individual foods. It

represented one way of actually testing for the degree of association between individual foods.

Food Group Construct Conclusion

According to research reviewed (Pilgrim and Kamen, 1959; Schutz et al., 1972; Schutz et al., 1975; Michela and Contento, 1984; Axelson et al., 1986), there appears to be support for the existence of these six food grouping constructs: "Fruits", "Vegetables", "Beans", "Meats", "Foods from Animals" and "Foods from Plants". The evidence is greater in quantity and quality for the salience of constructs "Fruits", "Vegetables", and "Meats".

"Vegetables" and "Fruits" appeared to be similar in that they were perceived as being healthful and nutritious and appropriate for lunch and dinner. On all other reported attributes, they were different. "Fruits" were seen as healthful, nutritious, tasty, sweet, juicy, served cold and uncooked, and eaten when not hungry. They were appropriate for breakfast, lunch, dinner, and the evening snack. They were not appropriate for use in the main dish, spiced, or boiled. "Vegetables" were healthful, nutritious, had strong flavors, were less tasty, cooked, and considered a common meal item. They were appropriate for lunch and dinner. They were not appropriate for breakfast, or an evening snack.

Little evidence could be found in this review to compare "Beans" and "Meats". "Beans" were apparently not identified as a major food grouping classification and therefore were not well characterized. They were, however, different from "Meats". Except for peanut butter, "Beans" were associated with "Plants", while "Meats" were associated with "Animals" in two

multidimensional scaling studies. According to research reviewed, the only associations between the two groups were possibly as specialty meal items and in their inconvenience. "Beans" were more associated with "Vegetables" or "starchy foods" than they were with "Meats". It was unclear how respondents described "Beans". They were associated with fresh vegetables (green beans) or starchy entrees (baked beans), depending on the kind of bean. Peanut butter seemed unrelated to other beans. "Meats" were nutritious and filling. They were appropriate for lunch, dinner, as the main dish or entree, and for common or specialty meals. They were inappropriate for breakfast, dessert, in a salad, or for an evening snack. Two multidimensional scaling studies mapped individual "Meats" as relatively tight clusters. If close proximity does indeed represent similarity, then "Meats", particularly the classic meats (beef, chicken, ham), were perceived as similar to each other and different from "Beans".

"Foods from Animals" and "Foods from Plants" were primarily distinguished as concepts through perceptual mapping techniques. Ambiguous foods, like mixed, unusual, or unknown foods, fell unpredictably along Animal-Plant dimensions. Unambiguous examples of "Fruits", "Vegetables", and "Beans" were found in the plant end of the dimension. Unambiguous examples of "Meats" are found in the animal end of the dimension.

These results were from samples that were not representative of the general population. Samples included children, homemakers, college students, patients, hospital staff, and soldiers. Middle-aged working men and women were not represented. Taken together, however, these samples

represent a broad base from which to look for perceptual consistencies. Consistencies did exist. These consistencies overcame, to some degree, the limitations of individual samples. It is fair to say that differences did exist, for wide segments for the population, between the three food grouping construct pairs of interest in this dissertation.

None of the papers reviewed scaled food grouping constructs or directly tested them for difference. All studies were based on explorations for patterns underlying scaled perceptions of individual foods. Without further research it is impossible to determine exactly how well differences between individual foods correspond to differences between groups.

CHAPTER 3

METHODS

The purpose of this research was to test for similarity between specific food grouping constructs according to a series of audience derived attributes. The intended units of study were food grouping constructs themselves. Respondents were required to generate natural language attributes related to the constructs in question. Later, additional respondents directly scaled their opinions and beliefs regarding these construct attributes (stimuli). The question asked was one involving a comparative test of perceptions. Do respondents perceive differences between the constructs X and Y according to a series of attributes. This approach differs from previous research in the stimuli used, the questions asked, and the analytic techniques used. Previous research, cited in chapter 2, used individual foods as stimuli, not groups. The question they asked was: what are the underlying or semantic meanings for foods. They did not ask research questions regarding the equivalence or difference of food grouping constructs as does this project.

In these earlier studies, semantic meanings for foods were derived from direct ratings of attributes, from factors of factor analyses, or from inter-point distances of multidimensional scaling analyses. Factor analyses were done on data generated from so-called bi-polar scales or from specific foods scaled across so-called food-related attributes. Food related attributes used as scaling stimuli were typically predetermined by researchers and not

derived directly from consumers. Food stimuli rated across attributes were represented by individual foods rather than food groups. The purpose of these studies was to characterize individual food items from the consumers perspective represented by those underlying meanings. This hypothetically would provide a basis to develop food classification systems that reflect how the users themselves would group foods. Such food classification systems could then be used in food guidance. These techniques provided valuable information regarding foods but only indirectly dealt with food group differences.

The approach of this research changes the unit of study from individual foods that show individual variation, to a direct assessment of grouping constructs. At this time it is unknown if individual food variations are relevant at the group level. So to determine if groups are similar, the most direct and logical approach is to study the variation of intact groups. A method is needed that directly tests for differences between a series of attributes used to represent food grouping constructs. Hotelling's T^2 (Morrison, 1976) is a test statistic designed to accomplish such a task. Previous research used factor analysis and multidimensional scaling programs to generate underlying patterns for sets of variables. These techniques do not, in themselves, provide direct test statistics of differences between variables as does Hotelling's T^2. Therefore this research differs in the analytic techniques used from those of previous research.

The scaling of attributes in previous research has primarily been at the ordinal level of measurement. Three to nine-point scales predominated. Hotelling's T^2 assumes at least interval level data; ratio scaling of

attributes satisfies this assumption of the test statistic. In addition, ratio scaling provides data that can be compared by degree, not just by kind (Cureton, 1968). For instance, "Fruits" may be found to be subjectively sweeter than "Vegetables" by ordinal, interval, or ratio scales, but only the latter can indicate precisely how much sweeter.

In order to conduct research involving human subjects, Michigan State University requires that approval be obtained from the Michigan State University Committee on Research Involving Human Subjects (UCRIHS). This is done to protect the rights, dignity and safety of participants. A proposal was submitted to UCRIHS and approval was obtained (Appendix A).

This chapter describes the purpose, procedure, and results of preliminary research. Hypotheses are operationally defined using those results. The procedure and data analyses of the final survey research are described.

Preliminary research

Preliminary research was conducted for four reasons: to determine if further investigations were warranted, to record consumer-generated natural language labels for food groups, to generate attributes associated with food grouping constructs, and to determine a criterion pair to be used as the standard metric for paired comparison (Woelfel and Fink, 1980) scales. The criterion pair represents the difference or distance rule respondents would use to scale concepts in a paired comparison task. This section includes methods and selected results and discussion from preliminary research.

Results and discussion were included because they contributed to the development of the final telephone survey questionnaire.

A total of ninety-eight completed interviews were conducted for four preliminary research studies. Respondents represented convenience samples of shoppers from the Meridian Mall in Okemos, Michigan. Permission to conduct interviews was obtained from mall management. Interviews were conducted during a 7 week period from May 9 to June 28, 1985. Shoppers were approached as they strolled slowly or sat in the median areas; those rushing about were not approached. A semi-systematic effort was made to maintain an even proportion of males and females. If several respondents of one sex were interviewed in succession, a greater effort was made to approach the other sex for the next several interviews. Persons included in this preliminary research were greater than 17 years of age and able to communicate coherently with the interviewer.

Shopping mall respondents were not representative of the general public. This mall was located near a major educational institution (Michigan State University) in an area of middle to upper income homes. The mall was visited by a high proportion of working-class, middle, and upper income whites and females. Most of the stores in the mall had prices that would attract only middle to upper income shoppers. Males were present but in smaller proportion and typically found waiting for female companions who were shopping.

Props used throughout the preliminary research included 64 National Dairy Council Food Models© (Appendix B). Food models chosen for this research were selected to match those represented by the protective foods of

three food guidance systems: The Daily Food Guide, the Guide to Good Eating, and the pre-release version of the EFNEP Food Planner. The first two are the most commonly used and disseminated food guides in the U.S.. The third represents food groups that split "Vegetables" and "Fruits" as well as "Meats" and "Beans". A perfect match between foods illustrated on these guides and foods represented by food models was impossible since the food models were not originally designed for this project. Efforts were made to get an equal number of foods from the following six categories: 1) Meat, Poultry, Fish; 2) Beans; 3) Grains; 4) Fruits; 5) Vegetables; and 6) Dairy Products. A wide variety of bean and grain food models was not available. Models representing combination foods, unusual foods, fats, sweets, alcohol, or carbonated beverages were not included because the focus of this study was on traditional food groups that only contained foundation or protective foods. Dairy Council Food Models© are life-size color photographs of single servings of foods. They are mounted on thin cardboard cut to the size of the food. Each comes labeled with the name of the food and the quantity shown. For this study, the quantity was covered with white tape to reduce irrelevant information.

All potential respondents were approached with this opening statement. "Hi, I'm _(name)_ from Michigan State University. We are conducting an important scientific study of peoples' understanding of foods. Could you spare a few minutes to help with this study? Respondents were thanked if they said "no". If they agreed, they were instructed to participate in one of two ways.

For the first component of the preliminary research, 25 respondents participated in an open or unstructured sorting task[1]. They were seated at a portable table approximately 26" wide and 40" long, and were handed the pile of 64 Dairy Council Food Models©. They were told the following.

> Here are foods pictured on cardboard. Please sort these foods into piles that make sense to you. You can make as many or as few piles as you feel necessary.

The term "piles" was used to avoid possible bias caused by the use of the term "groups". If respondents expressed confusion or a need for further direction, they were told that this was not a test and that there were no right or wrong answers. Once the sorting task was finished, respondents were asked to label each pile and then complete some demographic information. The open sort questionnaire is found in Appendix C. Pile labels and contents were recorded immediately following the interview to make food models

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1 No name could be found in the literature for this very basic free-form sorting process. It can be said to be similar to only the initial stage of the unstructured Q-sort described by Kerlinger (1973). The goal of Kerlinger's model is to eventually form a Q-distribution from categories formed for further analyses. In contrast, the primary goal of the open sort of this research is to obtain absolute frequencies of nominal groups labeled by respondents.

This sorting task differed slightly from the technique used by Michela and Contento (1984). Their instructions were more specific. They asked children to "classify foods into groups containing foods that were alike in some way or should be in the same group for any reason." In the present research the term "groups" was not used.

available for the next interview. Pile labels were recorded verbatim; similar sounding labels were not combined for the initial analysis.

As previously stated, the goals of this part of the preliminary research were to determine if further research was warranted and to generate natural language labels for food groups to see how they would match up to the ones being tested. **Results showed that no respondents classified foods into the four food groups.** Verbatim labels given for the 7 most frequently identified groups were "Fruits", "Vegetables", "Dairy Products", "Meats", "Protein", "Grains", and "Breads". (Figure 5)

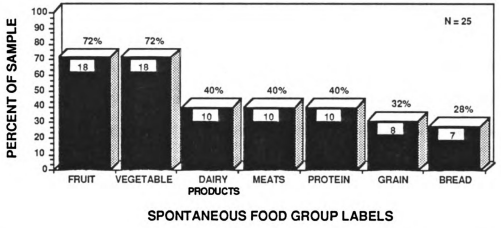

Figure 5. FREQUENCIES AND LABELS FOR FOOD MODEL PILES
Results of an unstructured sorting task by 25 shopping mall respondents. Only the most frequent responses are shown. Pile labels reflect verbatim responses. Counts are embedded in columns.

The mean, median, and mode for number of spontaneous piles created was seven with a standard deviation of three. Therefore, respondents had more groups than four with less elaborate labels than are used in the Daily Food Guide. Eighteen respondents (72%) created separate "Fruit" and

"Vegetable" groups. Only one labeled a combined "Fruits & Vegetables" group. No beans were placed in piles with "Meat" labels. Beans and non-red-meats like "light" meats[1], and eggs were occasionally included in "Protein" piles. Red meat representatives of beef or pork were not found in "Protein" piles. Only five respondents included both plant and animal sources together within a "Protein" group. This is weak evidence, at best, for combining "Meats" and "Beans", or "Food from "Animals" and "Plants" in the same food grouping constructs.

These results provided evidence for the theorized rejection of all the hypotheses. These data in combination with evidence from the literature review supported the notion that further research was warranted.

The second phase of the preliminary research involved a different task for 73 additional mall participants. The primary objectives of this component were to help determine if further investigations were warranted, to establish a criterion pair for a later paired comparison task, and to produce consumer generated food group attributes for final hypothesis testing. Persons were approached as in the first phase of preliminary research. Once consent was obtained, respondents were instructed to sit facing a vertical stand approximately 32" wide and 42" tall (Figure 6).

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1 Light meat" was used by some respondents to describe poultry, fish, and eggs. Red meats were not included in this categorization.

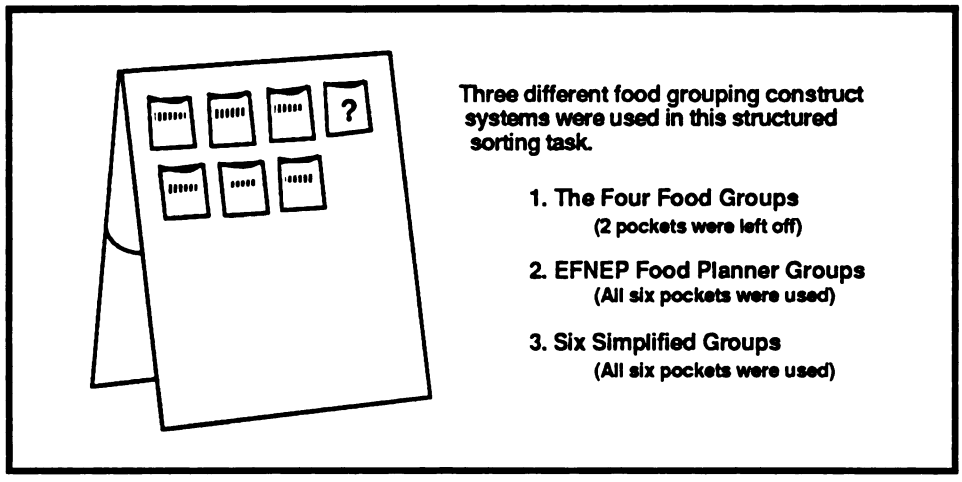

Figure 6. SORTING STAND
Structural form of the food model sorting stand used by 73 shopping mall respondents.

On this stand were pockets labeled with food groups and a question mark. Three full sets of food group labels were used. One set represented the four food groups of the Daily Food Guide plus a question mark. The next represented six groups of the EFNEP Food Planner plus a question mark. The last represented six simplified groups plus a question mark. This last grouping system was derived from informal interviews conducted earlier in the research process. Exact labels were "Meats", "Beans", "Fruits", "Vegetables", "Grains", and "Dairy". The Daily Food Guide version of the questionnaire can be found in Appendix D. A respondent was exposed to just one of the three food grouping systems. Respondents were asked to sort the 64 Dairy Council Food Models© into pockets they associated with the food model. If they were unsure about membership, they were to place the model into the question mark pocket. This task accomplished two things. First, it provided an indication of the ability of respondents to accommodate

different labeling systems; and second, it provided a time for respondents to become more familiar with the groups presented prior to the next task.

Respondents were then asked to scale inter- and intra-group differences between food grouping constructs, depending on the food grouping system represented. This was a ratio paired comparison process. The procedure was verbalized as follows.

> Now we are going to use numbers to rate "how different" certain foods are. The numbers go from 0 to 100. Zero means the foods are identical to you. One hundred means the foods are totally different to you. You can use any number from 0 to 100 to show how different you feel the foods are. Now, how different are ...

At this point the researcher pointed to one food grouping construct and said it out loud; then he pointed to the second, and said it out loud and then recorded the responses. Four types of food grouping constructs were scaled for each grouping system: "Meats", "Beans", "Vegetables", and "Fruits". The exact labels presented depended on the food grouping system displayed. For example, representatives of the "Meat" group were "Meat,Poultry,Fish" (Daily Food Guide), "Meat,Poultry,Fish,Eggs" (EFNEP Food Planner), and "Meats" (simplified six-group system). Note that the "Bean" end on the Daily Food Guide's representative was omitted. This was because, even though "Meat,Poultry,Fish,Bean" was the label on the pocket, there were, for our purposes, two stimuli present, "Meats" as "Meat,Poultry,Fish" and "Beans" as "Beans". So the question was asked like this, "how different are..." "Meat,Poultry,Fish" while pointing to the "Meat,Poultry,Fish" end of the label, and "Beans", while pointing to the Bean end of the label. This complicating

problem only existed with the Daily Food Guide which combines the four groups of interest into two. The other two grouping systems had separate pockets for each of the six food grouping constructs. Here is the generic representation of two of the scale questions asked:

Bean Representative.....and..... Meat Representative _____

Fruit Representative.....and.....Vegetable Representative _____

The results of this scaling procedure provided further evidence that "Meats" were different from "Beans" and "Fruits" were different from "Vegetables". If groups within a comparison were perceived as the same, a value close to zero was given. The closer the number towards 100, the greater the difference. The mean difference between "Meat" and "Bean" constructs over all 73 respondents was 65.5 with a standard deviation of 33.1. The mean difference between "Vegetable" and "Fruit" constructs was 42.5 with a standard deviation of 27.9. These values indicated opinions fundamentally different from zero. Further investigation was warranted from these preliminary results.

This scaling procedure also provided the means to identify the criterion pair for paired comparison scaling. Criterion pair selection followed the recommendations of Woelfel and Fink (1980). The difference between "Vegetables" and "Fruits" was in the middle range of the scale and had the smallest standard error of all measures taken. So "Vegetables" and "Fruits" were selected as the criterion pair.

Little is known about the relationship between attributes of individual foods and those of food grouping constructs. Until such information is

available, attributes of food grouping constructs should be representative of themselves and not of individual foods. Individual food stimuli might elicit different responses than group stimuli. If that were the case, then inference based on individual foods would lead to erroneous conclusions about the objects of the study, food grouping constructs. To test the hypotheses, new attributes were derived from consumers from direct reference to food grouping constructs as seen in the last phase of preliminary research.

Attributes associated with food grouping constructs were generated for the final part of the questionnaire. To do this, consumers were asked for qualitative responses from the same construct pairings: How are they different and how are they similar? These were open-ended questions intended to generate attributes by frequency of response. All top-of-mind responses were tabulated and the most frequently mentioned attributes, positive or negative, were used in the final questionnaire.

Attributes found to be most prevalent from these data (open sort pile labels and open-ended similarity/difference responses combined) were the following: used as main dish, side dish, breakfast, dessert, or snack; degree of work to prepare, or like to eat; amount of protein, fat, or vitamins it contains; how sweet, filling, juicy, nutritious or good-for-you.

Final Research

Survey Method

A cross-sectional Telephone Survey was used to test the hypotheses. Local telephone survey research has the advantages of being relatively

inexpensive, accessible to a widely scattered audience without having to travel, convenient for repeated call-backs, a non-physical way to enter the home, and it allows for the centralized training and supervision of personnel (Luck et al., 1982). Telephone survey research is inexpensive when calls are conducted by unpaid student volunteers and no utility charges are made per call.

The Sample

Systematic Random Digit Dialing (Sudman, 1976) was used to obtain 162 adult participants from the mid-Michigan local phone calling area. The local phone calling area was chosen for the cost saving advantage over a larger scale study requiring long distance calls. Calls were made by interviewers from the campus of Michigan State University. Surveys were conducted over a 2-week period from November 9th through the 21st, 1985. Respondents had to be over 17 years of age and able to communicate adequately, in English, over the phone in response to questions. Adults were the focus of this study following the reasoning that they would be representative of social convention and pressures related to foods and food classification (Guthe & Mead, 1945). Children were assumed to be more reflective of immediate family conventions and pressures, or developmental stages (e.g., Michela & Contento, 1984) and were, therefore, not included in the sample. The target sample size chosen for this study was 160 to allow 2 x 2 or 2 x 3 contingency tables to have 25 to 40 respondents per cell. Certain statistical tests including the students-*t* and *chi* -square depend on sampling distributions that have $n = 30$ as the first major break below which are considered small sample sizes (Blalock, 1979).

The Instrument

The questionnaire (Appendix E) was developed on the basis of preliminary research and a formative pre-test evaluation. Formative pre-testing was conducted with thirty-five respondents from the sampling population before the final questionnaire was ready for administration. The survey instrument contained typical questions of demographics, such as age, sex, race, income, occupation, marital status, and family size. Open ended categorical questions regarding the meaning of food grouping constructs and attributes were devised. Respondents were asked to name foods that came to mind upon hearing each of the six food grouping constructs used for hypothesis testing. They were also asked to define attributes like "nutritious" and describe the difference between a "side dish" and a "main dish". Time considerations limited the number of descriptive, open-ended questions that could be asked. Exploratory questions were devised regarding personal involvement in food-related activities, sources of nutrition information, and basic food guidance.

Ratio scaling techniques were used to measure attributes generated from preliminary research. Ratio scales have an absolute zero point and equal intervals that can be manipulated mathematically. To generate ratio values a rule must be followed by which to judge magnitude. Ratio scales meet the mathematical assumptions of the most advanced data analytic techniques. Three types of ratio scales were used in the Final Questionnaire: Percent estimate (Stevens, 1957), direct magnitude estimation (Stevens, 1957; Lodge, 1981), and ratio paired comparison (Woelfel and Fink, 1980; Woelfel and Barnett, 1982). The percent estimate scale, or simply a "percent

of total" scale, was worded as follows: "What percent of the time do your main dishes, side dishes, breakfasts, desserts, and snacks have certain kinds of foods in them?" Here are examples of the types of questions asked:

What percent of the time do your "Main Dishes" include "Fruits?"...

What percent of the time do your "Main Dishes" include "Vegetables?"...

What percent of the time do your "Side Dishes" include "Fruits?"... etc.

With this kind of scale the respondent has a zero point and a rule by which to judge magnitude. The rule is that the response given is a proportion or fraction (Stevens, 1957) of the full 100%.

Direct Magnitude Estimation (Lodge, 81), is where the respondent uses a comparative process to directly scale an opinion in reference to a standard value. Questions were worded as follows:

> Here we would like you to use numbers to rate if you think foods are above or below average in certain characteristics. On this scale, ten means average. To rate a food as being below average, say a number below ten. To rate a food as above average, say a number above ten. Zero means a food has absolutely none of the characteristic, and you can go as far up the scale as you want.

So, if ten means an average amount of...

Sweet,	how Sweet are...Fruits?
Work,	how much Work to Prepare are...Fruits?
Protein,	how much Protein is there in...Fruits? Etc.

The final measurement device was a ratio of paired comparison scale. This is where the respondent uses a comparative process to directly scale an opinion of dissimilarity between pairs of all constructs involved. The questions were asked in the following way:

Now we will use numbers to judge how different or "far apart" two foods are from each other. If you think there is no difference between foods, that is, you think that they are the same or identical to each other, say zero, which means no difference. The greater the difference, the further you go up the scale. Let's say that the difference between Vegetables and Fruits is ten. For differences larger than that, use numbers larger than ten; less different, use numbers less than ten. The larger the difference, the larger the number.

Now, if the difference between Vegetables and Fruits is ten, how different are...

Vegetables & Beans?
Fruits & Beans?
Beans & Vegetables?, Etc.

Interviewer training

Interviewers were given a set of guidelines (Appendix D) and individually trained, by a single instructor, in interviewing technique. Training included three monitored interviews, of which the first was tape-recorded. Questionnaires and the recording were reviewed by trainees with the trainer. Periodic monitoring was also done even though hypothesis testing questions required highly structured responses, not open to interpretation by interviewers. Interviewers were supervised on a regular basis by the principle investigator.

Interviewing Session

Numbers were dialed systematically until the phone was answered. Respondents were then told the following.

> Hi, I'm __(Name)__ from Michigan State University. We're conducting an important scientific study of peoples' understanding of foods. We have some questions we'd like to ask and assure you that all your responses are anonymous. Would you help us with this study?

If they agreed, questioning began. If anonymity was questioned, the respondent was assured that her/his number was randomly generated and that the researchers did not have access to her/his name or address. If they inquired about time, they were told that "the survey will take between fifteen and twenty minutes depending on how quickly we step through the questions". If at any point they declined to participate, they were encouraged once more to help because their opinion was important to us. If they still declined, they were thanked for their time and recorded as a refusal.

Series of questions relating to hypotheses tests and food listings were randomly rotated to lessen the chance of sequence effects. This was not true of the paired comparison task which was short. Pretesting found some food grouping constructs like "Meat,Poultry,Fish", "Food from Plants", and "Food from Animals" too difficult to start the paired comparison process so a specific sequence of increasing difficulty was selected. Terms like food groups and food guides were not used until the end of the survey so as to not bias responses.

Data Analysis

Questionnaires were coded, and data was transcribed into a hybrid data file that could be accepted by Mainframe and microcomputer statistics programs. Data file values were checked for accuracy using descriptive statistics to flag errors of misalignment or coding.

With one exception, each hypothesis was tested using Hotelling's multivariate one-sample T -test and a univariate one-sample t -test. This approach was designed to test hypotheses on two levels. The multivariate level tested for overall equivalence by examining several construct-associated attribute measures simultaneously. The multivariate result was explained by the examination of those individual attributes. The univariate level served as a direct test of equivalence using the constructs themselves as stimuli. The outcome of the direct test was compared to that of the indirect attribute-centered multivariate test. For reasons to be discussed, the one-sample t -test was not applied to "Vegetable" and "Fruit" construct measures.

Hotelling's T^2

Hotelling's one-sample T -test (T^2) (Morrison, 1976) is the simplest case of the multivariate analysis of variance. Multivariate statistical analysis is concerned with data collected on several dimensions of the same individual (Morrison, 1976). The T^2 statistic is a generalization of Student's t to multiple criterion measures (Hotelling, 1931).

The function of Hotelling's T^2 is to test a vector of multivariate normal means against a second vector of corresponding means. It tests for overall difference between two vectors taking into account intercorrelations between the sets of scores. It assumes random samples, normal distributions, and homogeneity of variance between covariance matrices in the two sample case (Green and Carroll, 1978). In the one sample case only the first two assumptions apply because there is only one covariance difference matrix. The one-sample test is appropriate for this research.

Violations of the normality assumption may cause an increase in type 1 error for single sample Hotelling's T^2. This is particularly true for lognormal (positively skewed) sample distributions. This situation becomes progressively worse as the number of variables is increased. It has been recommended that skewed data be transformed to approximate normality whenever possible. Hotelling's T is robust concerning departures from normality due to kurtosis. (Everitt, 1979)

Ratio estimates of unbounded scales are typically lognormal (Moskowitz, 1974). Univariate & multivariate t -tests assume normality. The closer to normality, the better the estimation of probability levels. Frequency distributions were graphically & statistically analyzed for normality to determine if transformations were indicated. It was expected that all open-ended ratio scales would be positively skewed. An "ln (X + 1)" transformation changes a positive skew to a better approximation of normality. The "+1" retains the zero point following the transformation. Statistical Package for the Social Sciences, T -test , Option 5[1], was used to conduct the paired variables Hotelling's T^2 procedure[2] (Nie et al., 1975).

Hotelling's one-sample T^2 was used in preference to individual t -tests[3]. In an ordinary t -test, only one set of variates is involved. In a

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1 T -test, Option 5 was found in an SPSS-6000 Version, 7.0 Update.

2 An alternative Hotelling's T^2 procedure to the one used in this study is listed under SPSS's subprogram Reliability. This alternative procedure, however, is not well documented and reported inaccurate degrees of freedom. Deaton (1982) showed a way to correctly program the Reliability version of Hotelling's T^2 for matched group designs.

3 Individual t -tests are, however, useful for exploration and are automatically calculated by SPSS in every Hotelling's run.

situation where more than one pair of variates is involved (the multivariate case) there is an increased risk of type I error if a series of individual *t* -tests are done. This can happen by chance alone, or because two or more sets of variates are not independent of one another. If one set of variates is found to be significantly different, and that set is highly correlated with a second set, then the result of the second is predictable from the first. In this case two significant differences do not signify increased evidence of difference between the two contrasts. To control for this problem, Hotelling's T^2 pools the within groups covariance matrix. This takes within-groups correlations into account to prevent an artificial increase in the chance of a multivariate significance finding (Green and Carroll, 1978).

Hotelling's T^2 has been used successfully in a variety of research studies. Naitoh et al., (1971) used it to determine differences in brain wave activity. They measured the decline of negative electroencephalo-graphic (EEG) potentials in 8 Navy personnel during sleep depravation. A series of baseline EEG levels were compared to a corresponding series of levels recorded through 2 days sleep depravation and recovery. Hotelling's T^2 was instrumental in determining at what point of sleep depravation EEG's had significantly declined and recovered to normal levels. Naitoh and co-workers (1971) demonstrated that this test was a useful tool to determine at what point, not just if, a difference in a physiological parameter exists.

Crary and Ridgway (1971), used Hotelling's T^2 to determine the strongest multivariate association between reading achievement and three learning abilities. Their purpose was to test if visual discrimination ability was more highly correlated with reading ability than with visual motor ability.

A series of vectors of correlation values were used to test their hypothesis. Correlations between standard reading and visual discrimination tests made up one set of vectors of values. Correlations between the same standard reading and visual motor ability tests made up the corresponding vectors of values. Sixty, one-tailed T^2s were conducted to determine if positive significant differences existed for their hypothesis. Crary and Ridgway (1971) demonstrated that Hotelling's T^2 was a useful way of determining multivariate links between learning abilities and achievement.

The next two papers involved the study and testing of human perceptions or behavioral reports. Kjerulff and Blood (1973), studied communication patterns of male and female graduate students in the context of a theory on differential achievement. They wanted to know if patterns of verbal communication with professors and peers were different for female and male graduate students. Variates used in the test were number, length, quality, equality, and informality of discussions with research advisors. Variates relating to other students included number of discussions, their utility, and amount of information obtained. They concluded from their Hotelling's T^2 analyses that males and females had different communication patterns though not at the 0.05 probability level predicted. These patterns were tested using a number of attributes (opinions and behavioral self-reports) regarding a stimulus phenomenon, the communication process.

Gordon and Petty (1971) studied the tendency of 79 insurance agents to fake responses under two different conditions of anonymity. This research was conducted at a company sponsored prospecting workshop. This study

was about the difference in perceptions of beliefs, feelings, and action tendencies of two groups towards the stimulus object, "prospecting". Six measures of beliefs, feelings, and action tendencies toward prospecting for clients were used as variates. Using Hotelling's T^2 Gordon and Petty found that the "totally anonymous" group differed from the "identified but confidential" group. Respondents who were told the study was anonymous reported more negative opinions that showed less variance per measure than the "identified" group.

The studies cited above show different applications of Hotelling's T^2 to multivariate testing situations. The last two most directly pave the way for the current research because the goal is to test stimulus objects (food grouping constructs) using attributes (behavioral self reports, opinions, and beliefs) for difference.

The test for differences between pairs of food grouping constructs is depicted in Figure 7. Here, for instance, "Vegetables" and "Fruits" were assumed to be a repeated measure of the same thing within the same sample. In this case, three vector pairs of 19 attribute measures apiece were compared simultaneously taking into account the number of individual attributes involved and the magnitude of difference of each individual pairing. Hotelling's T^2 provided a single statistic that indicated if any of the pairings were different.

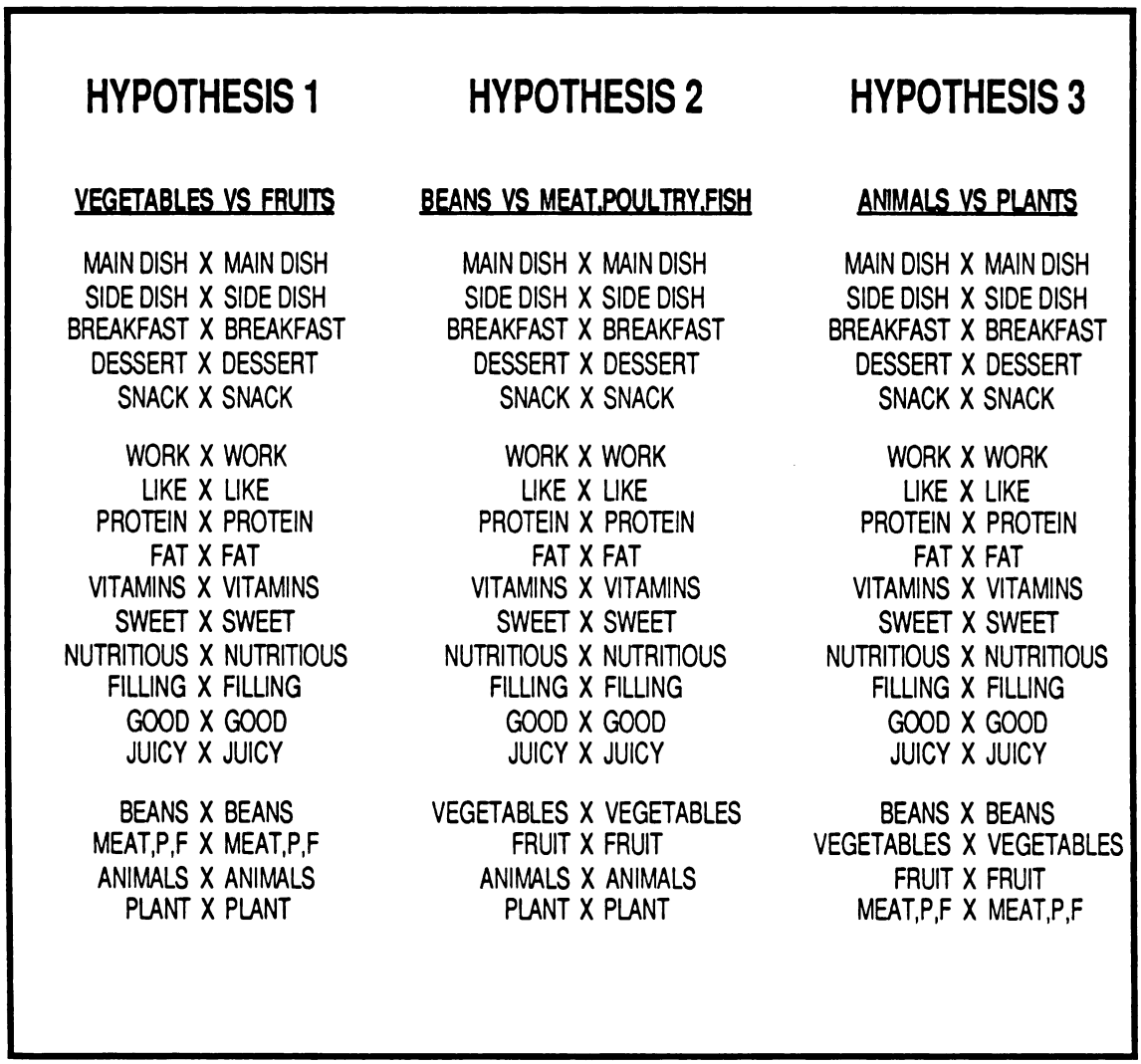

Figure 7. HOTELLING'S T^2 HYPOTHESIS TESTS

Multivariate attribute vectors showing the three contrasts to be tested by Hotelling's T^2 statistic. These contrasts represent the three multivariate hypothesis tests.

The one-sample Hotelling's T^2 statistic is given by the following formula adapted from Morrison (1976) to suit a repeated measures case. Since, for example, "Fruits" and "Vegetables" are included within the same group in the Daily Food Guide, measures on "Fruits" were treated as repeated observations of measures on "Vegetables" for this analysis.

$$T^2 = N\,(\bar{\mathbf{x}} - \bar{\mathbf{y}})'\mathbf{S}^{-1}(\bar{\mathbf{x}} - \bar{\mathbf{y}})'$$

Where... N = sample size
$\bar{\mathbf{x}}$ = vector of sample means for construct X.
$\bar{\mathbf{y}}$ = vector of sample means for construct Y.
$\mathbf{S}$ = sample covariance difference matrix.

The probability distribution followed by Hotelling's T^2 is a transformation of the F -distribution.

$$T^2 \frac{N - P}{P(N - 1)} = F_{\alpha;P,N-P}$$

Where... P = total number of variates (number of attributes) in the multivariate test

Degrees of freedom are P for the numerator and $N - P$ for the denominator. F -values were estimated from the Z-distribution using the Cornish-Fisher approximation (Fabian & Hannan, 1985).

The decision rule for a test of level alpha is, accept H_0: $\mu_X = \mu_Y$ if...

$$T^2 \leq \frac{P(N-1)}{N-P} F_{\alpha;P,N-P}$$

Simultaneous Confidence Intervals

Hotelling's T^2 may reject a multivariate null hypothesis, but it will not tell you which of the individual attributes tested most probably led to that rejection. A technique was needed to establish confidence intervals for all attribute comparisons that would not increase the chance of a type 1 error. The method of simultaneous confidence intervals (SCIs), as described by Morrison (1976) and derived by Roy & Bose (1953), was conducted to see how each individual variate comparison contributed to the significance of the overall multivariate test. SCIs take into account the variance, the sample size, and the total number of variates in its calculation. This is a more precise method of estimation than simply conducting individual *t*-tests and arbitrarily adjusting the alpha levels. The StatView microcomputer statistics program (Gagnon et al., 1986) was used to compute SCIs using the following formula adapted from Morrison (1976):

$$\bar{x}_p - \sqrt{\frac{1}{N}\sigma_p^2 T_{\alpha;P,N-P}} \leq \bar{x}_p \leq \bar{x}_p + \sqrt{\frac{1}{N}\sigma_p^2 T_{\alpha;P,N-P}}$$

Where...

N = Sample size

P = Number of total variates from the multivariate test

p = The variate whose confidence interval is calculated

$\bar{x}_p$ = The mean difference between 1st and 2nd measures of variate p

s_p^2 = The variance of difference values of variate p

Variates (attributes) whose confidence intervals did not cross the zero difference value at the 99% confidence level were tabulated into a profile of differences.

The three hypothesis tests of this study involved 19 difference variates apiece; thus a total of 57 difference variates were involved. Split-sample reliability tests (Tull & Hawkins, 1984) were conducted on this data set. The sample was divided into two groups by odd and even respondent I.D. numbers. Here is an example of how reliability coefficients were calculated. Each "Even" respondent's "Vegetable" values were subtracted from her/his "Fruit" values for each of the 19 attributes. Nineteen attribute difference averages were calculated. The same process was done for the "Odd" respondent group. The result was two vectors of 19 attribute difference means apiece. A correlational analysis was run between "Odd" and "Even" subsamples to determine reliability. The degree to which the vector of "Odd" attribute difference means followed a reliable pattern with the "Even" vector

determined the size of the reliability coefficient (coefficient of determination, R^2). The R^2 was calculated for the following three comparisons:

1) Nineteen "Vegetable"-"Fruit" difference variates.

2) Nineteen "Meat"-"Bean" difference variates.

3) Nineteen "Animal"-"Plant" difference variates.

Univariate One-Sample *T*-test

An additional statistic was used to test the hypotheses. Univariate one-sample *t* -tests were conducted on paired comparison difference data using the StatView 512+ microcomputer statistics program (Gagnon et al., 1986). The following formula was used by StatView™.

$$T = \frac{\bar{x} - 0}{\sqrt{(\Sigma x_i)^2 - \frac{\Sigma (x_i)^2}{N(N-1)}}}$$

Where... x_i = an individual's lognormal paired comparison difference value

x = mean of lognormal paired comparison difference values

0 = hypothesized mean of zero

$N - 1$ = degrees of freedom

Paired comparison data provided a direct measure of an overall perceived difference between "Meat, Poultry, Fish" and "Beans", as well as between foods from "Animals" and "Plants". So, in the second test of the

hypotheses, mean paired comparison difference values were tested against hypothesized values of zero.

NULL HYPOTHESIS 1:

(Not tested due to constraints mentioned below)

NULL HYPOTHESIS 2:

MEAT,POULTRY,FISH — BEANS = 0

NULL HYPOTHESIS 3:

FOODS FROM ANIMALS — FOODS FROM PLANTS = 0

In the ratio paired-comparison measurement system used for these tests, larger numbers represent larger differences, a value of zero represents "no difference". Two constructs were interpreted as equivalent if their mean difference value was not significantly different from zero at the .001 probability level.

The high probability level was used because of evidence from the literature and preliminary research suggesting that the food grouping constructs in question are judged by multiple attributes. If the magnitude of responses are reflective of a selective focus on attributes with greatest perceived differences, an overall significant finding is more likely. If the magnitude of responses are reflective of a selective focus on attributes of greatest perceived similarity, a nonsignificant finding is more likely.

As mentioned before, “Vegetables” and “Fruits” were constrained to a difference of "10"; the criterion pair difference value. This artificially forces a statistical difference because the hypothesized difference value (0) can not

be the same as the set criterion pair difference value (10). Since the hypothesized difference between constructs was set at zero, the criterion pair value (the set difference between "Vegetables" and "Fruits") was excluded from this analysis.

Summary

This chapter differentiated the approach taken here with that of previous research. This research focused on food grouping constructs, used respondent derived attributes as stimuli for scaling, and provided a direct test of similarity from ratio scaled data. In contrast, previous research used individual foods as the unit of study, derived researcher labeled attributes or constructs as stimuli for scaling, and mapped constructs as factors in multidimensional factor space from ordinal data.

Preliminary and final research procedures were discussed in detail. Preliminary research was conducted to provide information useful for the development of the final survey instrument and for the testing of hypotheses. The primary function was to generate attributes associated with food grouping constructs to be scaled in the final survey for use in hypothesis testing.

A cross sectional telephone survey of 162 adult consumers was used for the scaling of construct attributes. Sample selection, survey instrument content, and the interviewing process were briefly discussed. Specific questions dealing with hypothesis testing were presented in some detail.

Data analyses were discussed. Data were coded, transformed to normality where possible, and tested for the acceptance of the null

hypotheses using Hotelling's T^2 statistic and the univariate t-test. These tests were defined, and their properties discussed. Multivariate hypothesis tests were operationalized using the attributes obtained through preliminary research as stimuli. Univariate hypothesis tests were operationalized using food grouping constructs as stimuli. Simultaneous confidence intervals were discussed as the means used to judge which of the attributes led to significance in the multivariate test.

CHAPTER 4

RESULTS & DISCUSSION

The purpose of this research was to investigate consumer perceptions of food grouping constructs as represented by major distinctions between the Daily Food Guide and the EFNEP Food Planner. Those distinctions included the grouping or separation of "Fruits" and "Vegetables"; "Meat, Poultry, Fish" and "Beans"; and "Food From Animals" and "Food From Plants." More specifically, the research problem was to determine if consumers perceived "Fruits" and "Vegetables" to be equivalent; "Meat, Poultry, Fish" and "Beans" to be equivalent; and "Food From Animals" and "Plants" to be equivalent according to relevant measures. The objectives of this chapter are to report and discuss the results of three hypothesis tests and related analyses.

Demographics

The 162 respondents were 68% female and 32% male. Ages ranged from 18 to 88 years with a mean of 39, standard deviation of 16, and median of 34. The sample was 90% white, 6% black, and 3% other. Fifty percent were married, 32% single, and 19% were divorced, widowed or separated. (Table 3) There were 2.8 persons, on average, per household, 0.8 of which were children. Occupations were varied and included 24% white-collar workers, 20% homemakers, 14% blue-collar workers, 14% clerical workers, and 9% students. (Table 4) Income was varied. Thirty percent of the sample made less than $15,000, 39% made $15,000 to $40,000, and 27% made

more than $40,000 (Table 5). Thirty-eight percent of the sample had at least a college degree, 33% took some college courses, and 29% never went beyond high school (Table 6).

Table 3. DEMOGRAPHICS: GENERAL DESCRIPTIVE STATISTICS

VARIABLE	DESCRIPTIVE STATISTICS		
SEX:	FEMALE (111) / MALE (51)	68% / 32%	
AGE:	AVE: 39 YEARS	SD = 16	RANGE 18 - 88
RACE:	WHITE / BLACK / OTHER	90% / 6% / 3%	
MARITAL STATUS:	MARRIED / SINGLE / DIVORCED	50% / 32% / 19%	
HOUSEHOLD:	AVE: 2.8 PEOPLE	SD = 1.5	RANGE 1 - 8
	AVE: 0.8 CHILDREN	SD = 1.2	RANGE 0 - 7

This sample differed from the general population (Anonymous, 1985d). In this sample there were a higher proportion of females, slightly higher income, higher educational attainment, and more single persons than the general population. The sample was 68% female vs a population of 51%. Twice as many persons in this sample (33% vs 15%) had at least some college. The sample was 50% married versus a population of 63%. Five percent fewer of this sample made less than ten thousand dollars per year than the general population.

Table 4. OCCUPATIONAL CATEGORIES

OCCUPATION	FREQUENCY	PERCENT
WHITE-COLLAR	38	23.5%
HOMEMAKER	32	19.8%
BLUE-COLLAR	22	13.6%
CLERICAL	22	13.6%
STUDENT	15	9.3%
RETIRED	14	8.6%
PROFESSIONAL	3	1.9%
UNEMPLOYED	2	1.2%
OTHERS	12	7.4%

N = 160 (2 MISSING VALUES)

Table 5. INCOME CATEGORIES

INCOME	Frequency	Percent
0 - 9,999	25	15.4%
10,000 - 14,999	24	14.8%
15,000 - 24,999	31	19.1%
25,000 - 39,999	33	20.4%
40,000 - 59,999	32	19.8%
60,000 - More...	11	6.8%

N = 156 (6 MISSING VALUES)

Table 6. EDUCATIONAL CATEGORIES

EDUCATION

Highest Level Achieved	Frequency/Percent	Cumulative Frequency/Percent
Grade School	8 (4.9%)	162 (100.0%)
High School	39 (24.1%)	154 (95.1%)
Some College	54 (33.3%)	115 (71.0%)
College Degree	28 (17.3%)	61 (37.7%)
Some Graduate	14 (8.6%)	33 (20.4%)
Graduate Degree	15 (9.3%)	19 (11.8%)
Professional Degree	4 (2.5%)	4 (2.5%)

N = 162 (0 MISSING VALUES)

Sixty-eight percent of the sample were females. It is possible that more females take on the responsibility of answering the phone. Twenty percent of the sample classified themselves as homemakers. The sample was taken from the greater Lansing area of Mid-Michigan. Higher education and income levels were probably a function of government and educational institutions within the sampling area. The greater Lansing area includes the state capital of Michigan and educational institutions like Michigan State University, and Lansing Community College.

This sample was more representative of the general adult population than previous studies scaling peoples' perceptions of foods. A reasonable, though not perfect, cross section of people was available through their telephones. Previous studies examined special classes of people like

students, homemakers, and hospital patients. Differences that did exist between the current sample and the general population may have some hidden advantages. A more educated sample may have had more academic training in the Basic Four Food Groups. If the hypotheses were all rejected with this group, they would likely be rejected for less educated persons who were not taught the Basic Four configuration. Also, If there are common conceptions regarding food grouping constructs, it is likely that they are passed on by homemakers. Lewin (1943) would call homemakers gatekeepers, those who controlled the exposure of the family to foods. Homemakers who control their families exposure to foods may also play a major role in the development of conceptions of foods by their family.

HYPOTHESIS 1

1. Ho : Respondents perceive no difference between the constructs "Fruits" and "Vegetables."

Using Hotelling's T^2, perceptual measures of "Vegetables" and "Fruits" were found to be significantly different over 19 attributes (Figure 8). The null hypothesis was rejected at the less than .001 probability level. To examine if this result could be attributed to different attribute/scale questionnaire subsets, three additional Hotelling's tests were conducted. The first subset included five foodway attributes, scaled by the percent estimate technique. The second subset included ten general attributes, scaled by direct magnitude estimation. The third subset included four difference attributes, scaled by the ratio paired comparison technique. All three subsets were significantly different at the less than .001 probability level (Figure 8). A one-sample univariate *t* -test was not conducted on the direct paired comparison between "Fruits" and "Vegetables" for reasons provided in Chapter 3.

Individual attributes are examined in detail in figures that follow. "Simultaneous confidence intervals" (SCIs) were calculated. Their purpose was to examine the 19 variates for difference without increasing Type I error as multiple individual comparisons would (Hayes, 1973). SCIs indicate which responses have probably led to the rejection of multivariate hypotheses (Morrison, 1976). SCIs shown in the following series of figures were calculated for the full 19 variates (attributes). Individual figures,

however, show only 4 to 10 variates at a time to improve readability. Two overall and three subset hypothesis test results are shown for "Fruits" and "Vegetables" in Figure 8.

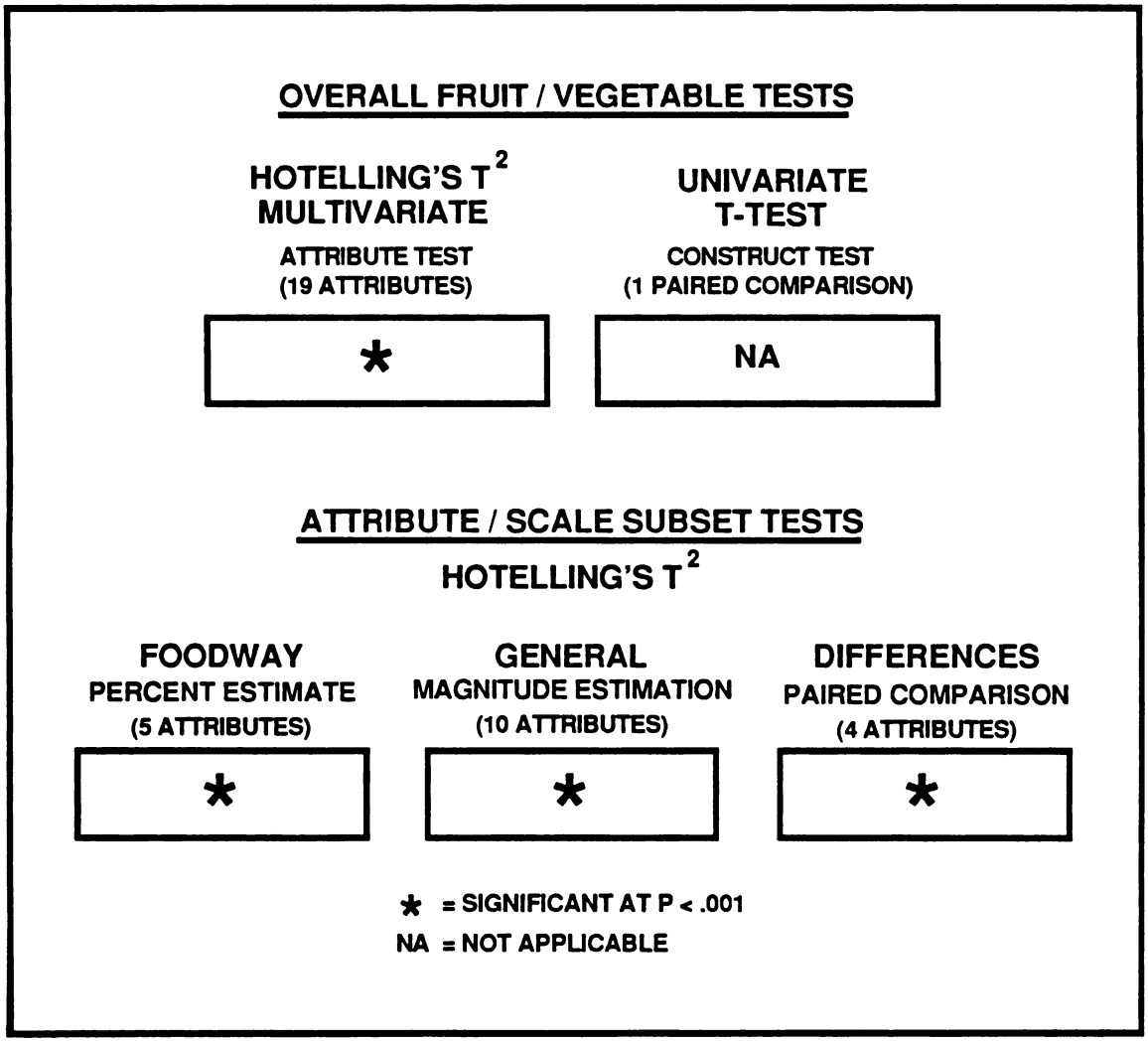

Figure 8. FRUIT / VEGETABLE HYPOTHESIS TEST RESULTS

Fruit-Vegetable Foodway Attributes: Percent Estimate Scale.

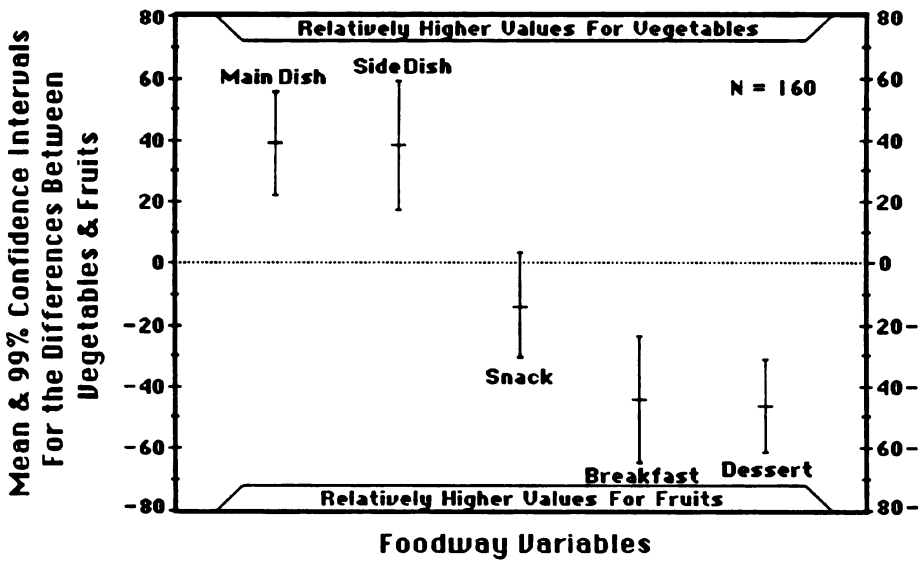

Figure 9. SCIs FOR FRUIT-VEGETABLE FOODWAYS.
Five of 19 simultaneous confidence intervals for difference values between corresponding foodway attributes of "Vegetables" and "Fruits."

Simultaneous confidence intervals for five foodway attributes are shown in Figure 9. Each attribute is represented by a vertical confidence interval, crossed at its center, by the mean difference between "Vegetables" and "Fruits." The vertical lines represent 99% confidence intervals. Those attributes whose confidence intervals do not cross the zero line are the best indicators of the difference between "Vegetables" and "Fruits." The zero line is equivalent to zero difference. The greater the difference, the further the mean difference is from zero. The further the mean difference, the less likely its distribution, and hence its confidence interval, will extend over the zero

line. Attributes whose intervals cross the zero line are not different at the 99% confidence level.

It can be seen from Figure 9 that the percent of the time that Vegetables were included in main dishes, side dishes, breakfasts, or desserts was significantly different from "Fruits." "Vegetables" were reported to have been included in significantly more main and side dishes than "Fruits". These results were not surprising. Twenty percent of respondents asked to define "Main Dish" specified "Vegetables" mostly as part of a "Meat", potato, and "Vegetable" meal. Forty-one (22%) respondents defined "Side Dish" as "Vegetables" or salad. "Fruits" were reported to have been included in significantly more breakfasts and desserts. These results are consistent with findings of earlier studies (Schutz et al., 1972; Michela and Contento, 1984; Axelson et al., 1986) except for snacks. Schutz et al. (1972) found "Fruits" appropriate and "Vegetables" inappropriate for snacks. Now, 15 years later, "Fruits" are still included in more snacks than "Vegetables", but the difference is not significant at the 99% confidence level. This could be attributed to health and nutrition campaigns by the government and advertisers promoting "Vegetables" as healthful, low calorie snacks.

SCIs showed where the greatest differences between "Fruits" and "Vegetables" existed. Those differences were the most likely causes of the rejection of the multivariate hypothesis. Figure 10 shows means of raw data values for the same variates as Figure 9 .

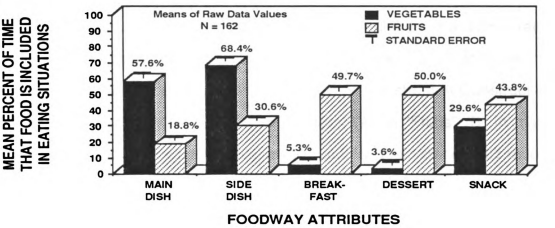

Figure 10. FOOD USES FOR FRUITS & VEGETABLES.
These are raw values for the attributes of Figure 9. They show mean percents of behavioral self reports comparing foodway attributes, "Vegetables" and "Fruits."

One benefit of the precision and proportionate nature of ratio scales is that different constructs scaled by the same criteria can be directly compared. Means, like those reported in Figure 10, represent summaries of raw values. A proportionate difference between means should not , however, be confused with a test for difference. SCIs are a test for difference. Proportional differences (ratio comparisons) tell you how different the means are, not how different the means are relative to their distributions. Mean values can differ but their distributions may overlap. So, SCIs show if a difference exists; means show the relative magnitude of that difference in the units of the original scale.

From Figure 10, it can be calculated that, on average, fruits were perceived to be included approximately 10 times more frequently than vegetables at breakfasts and 14 times more frequently for desserts.

Vegetables were perceived to be included in main dishes in a 3 to 1 ratio over fruits, and in a 2 to one ratio in side dishes. Some ratios that follow will be shown next to the attribute in this format: "(Construct A:Construct B Ratio)". For example, the ratio of "Vegetables" (A) to "Fruits" (B) in main dishes above would have been represented like this: main dishes (3:1 ratio).

Fruit-Vegetable General Attributes: Direct Magnitude Estimation Scale.

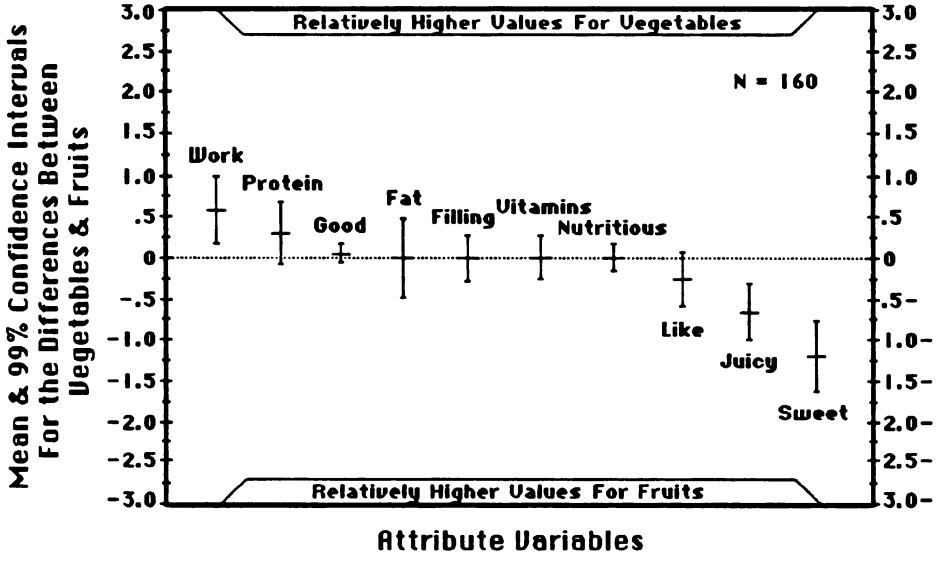

Figure 11. SCIs FOR FRUIT-VEGETABLE ATTRIBUTES.
These are 10 of 19 total simultaneous confidence intervals for difference values between corresponding general attributes of "Vegetables" and "Fruits."

Simultaneous confidence intervals for ten general attributes are shown in Figure 11. At the 99% confidence level "Vegetables" were perceived as

being significantly more work to prepare (5:3 ratio) than "Fruits". This would make sense if "Vegetables" are prepared as meal items while "Fruits" are eaten fresh and uncooked (Schutz et al., 1975). "Fruits" were perceived as being significantly sweeter (3:1 ratio) and juicier (2:1 ratio) than "Vegetables". "Vegetables" were perceived to have more protein than "Fruits". "Fruits" were liked more than "Vegetables". Raw data values for attributes are shown in Figures 12 and 13.

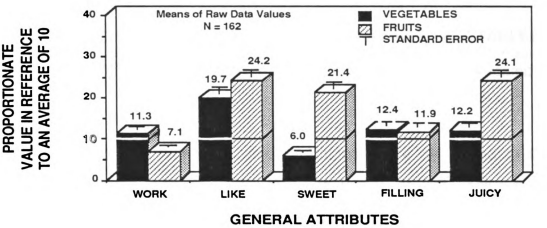

Figure 12. GENERAL ATTRIBUTES OF FRUITS & VEGETABLES. Raw mean magnitudes of "Vegetables" and "Fruits" scaled across attributes of Figure 11. "10" was defined as the "average" value.

"Vegetables" were found to be 13% more work to prepare than average (average = 10). "Fruits" were 29% less work than average. Respondents "liked to eat" both "Vegetables" and "Fruits." At the 99% confidence level, "Vegetables" and "Fruits" were not found to be different in amount of filling/fullness. In an univariate *t*-test, the probability that "Vegetable" and "Fruit" filling values came from the same population was .985.

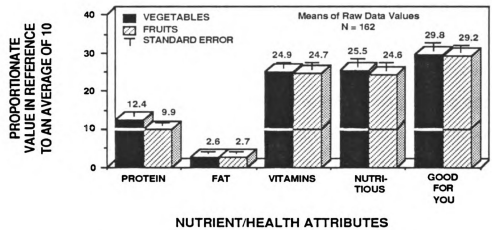

Figure 13. NUTRIENT/HEALTH ATTRIBUTES OF FRUITS & VEGETABLES. Raw mean magnitudes of "Vegetables" and "Fruits" scaled across attributes of Figure 11. "10" was defined as the "average" value for attributes scaled.

"Amount of fat", "vitamins", and "nutritious" were not found to be significantly different at the 99% SCI level (Figure 13). In fact, according to individual *t* -tests on these three attributes, evidence exists that "Fruits" and "Vegetables" came from the same population. Their respective probabilities were .947, .775, and .754. Individual *t* -tests were only used as a rough tool to estimate similarity. They were not used to determine difference because individual probability tests are inappropriate for the multivariate situation (Hayes, 1973).

"Fruits" and "Vegetables" were not perceived to be different from each other in relation to "vitamins", and "nutritious". These attributes may not distinguish "Fruits" and "Vegetables" as a single class of foods because "nutritious" and "amount of vitamins" are not exclusive properties of "Fruits" and "Vegetables". For example, "Meats" and "Beans" were also perceived as

being vitamin filled and nutritious (Figure 24). In fact, it is possible that any of the "protective foods" would be evaluated as vitamin filled and nutritious. During preliminary research it was found that respondents identified 'vitamins' as an attribute that "Fruits" and "Vegetables" had in common. When asked to name specific vitamins, most respondents gave no answers. One unanswered question is how important are vitamins and nutritiousness in terms of how people classify foods? Are the attributes so vague that they provide no basis for classification?

"Vegetables" were perceived as having more "protein" and "good-for-you" than "Fruits." Both "Vegetables" and "Fruits" were reported as average or above in "amount of protein" (Figure 13).

Fruit-Vegetable Difference Attributes: Ratio Paired Comparison Scaling.

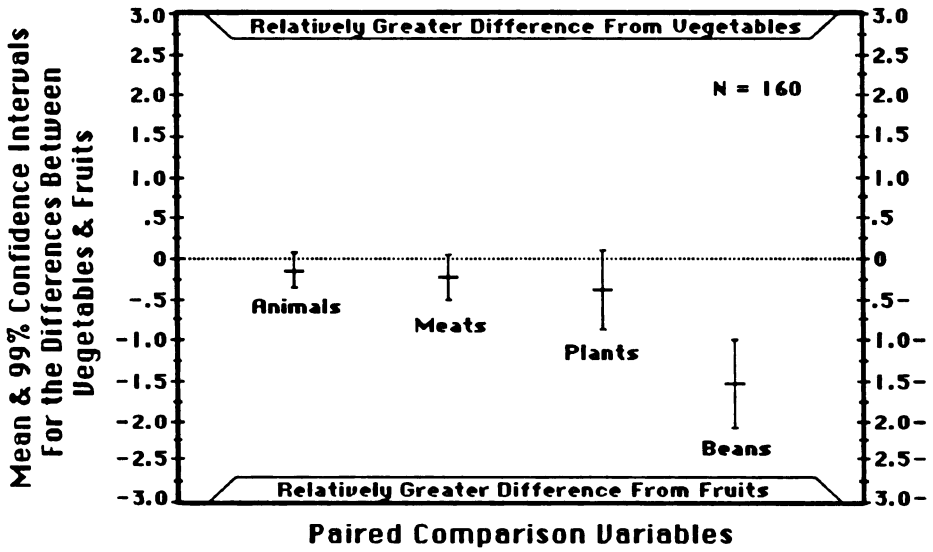

Figure 14. SCIs FOR FRUIT-VEGETABLE DIFFERENCES.
These are 4 of 19 simultaneous confidence intervals for difference values between four food grouping constructs and "Vegetables" and "Fruits."

Simultaneous confidence intervals for four difference attributes are seen in Figure 14. Simultaneous confidence intervals calculated for paired comparison data showed that "Beans" as a food grouping construct were significantly more different (4:1 ratio) from "Fruits" than they were from "Vegetables." "Foods from Animals", "Meat, Poultry, Fish", and "Foods from Plants" were more different from "Fruits" than they were from "Vegetables", though not at the 99% confidence level.

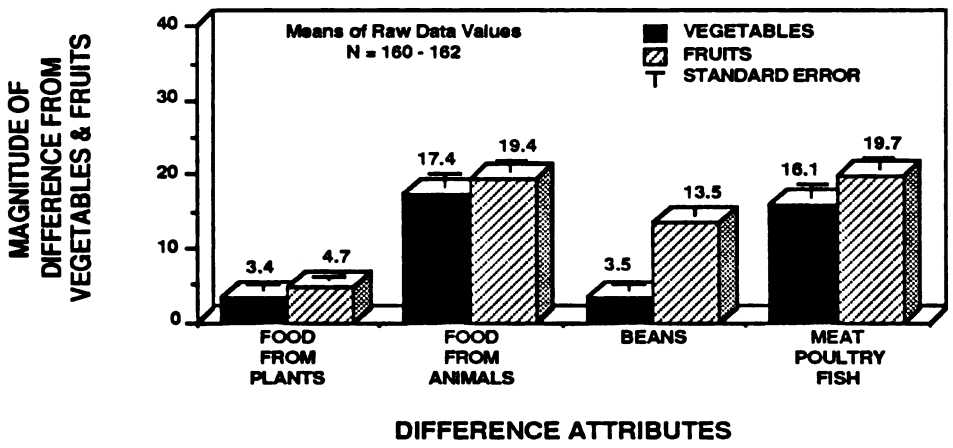

Figure 15. DIFFERENCE VALUES OF FRUITS & VEGETABLES.
Raw mean magnitudes of "Vegetables" and "Fruits" scaled directly against four other food grouping constructs (inter-group differences are used as attributes). The difference between "Vegetables" and "Fruits" was set as 10. All other differences were judged by this criterion pair.

The criterion pair, "Fruits" and "Vegetables" was set at 10 for the paired comparison scale. As can be seen from Figure 15, "Fruit" and "Vegetable" differences from "Food from Plants" were only half that criterion value of 10. Using this logic, "Fruits" and "Vegetables" were perceived to be more different from each other than they were to "Food from Plants." Both "Fruits" and "Vegetables" showed relatively high differences between themselves and "Animal" or "Meat" constructs. The only significant difference, however, was in relation to "Beans"; "Fruits" were perceived to be about four times more different from "Beans" than were "Vegetables."

To determine top-of-mind foods associated with food grouping constructs, respondents were asked to list foods that came to mind after hearing each construct verbalized. Frequencies of responses are reported in Figures 16 and 17.

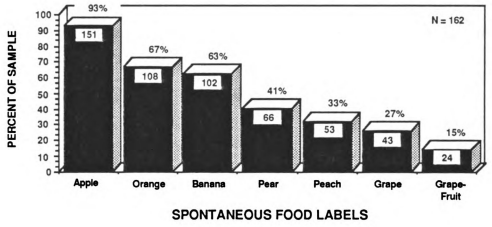

Figure 16. SPONTANEOUS FRUIT RESPONSES.
Frequency responses to the question: What foods come to mind when I say "Fruits"? Actual counts are embedded in columns.

Top of mind fruits reported most frequently included apples, oranges, bananas, pears, peaches and grapes (Figure 16). Top of mind vegetables reported most frequently were carrots, peas, broccoli, tomatos, cauliflower, lettuce, and potatoes (Figure 17). Beans were cited as "Vegetables" by 23% of the sample.[1] These frequencies may provide an indication of how attributes were judged. It is possible that responses to the stimuli "Fruits" was defined by its most top-of-mind members. These data indicate that respondents had preformed consistent responses defining "Fruits" and "Vegetables". Out of the infinite responses that could have been given for

1 Interviewers continued on to the next question after the first 3 to 5 responses. This was done to obtain frequencies of the most likely top-of-mind responses. Consequently frequencies obtained were small.

these items, 100% of the sample gave all "Vegetables" and 97% gave all "Fruits" to their prospective questions. Three percent called tomatos a "Fruit". These frequencies added further evidence to the theory that a consistent well defined predisposition exists regarding the perception of what a "Fruit" is and what a "Vegetable" is.

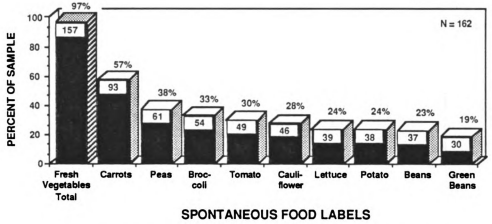

Figure 17. SPONTANEOUS VEGETABLE RESPONSES.
Frequency responses to the question: What foods come to mind when I say "Vegetables." Actual counts are embedded in columns.

A split-sample reliability test conducted on variables involving the "Fruit"-"Vegetable" data resulted in a coefficient of determination of 0.98. This high measure of reliability demonstrates the consistency with which respondents made their judgments across subsamples.

In conclusion, perceptual measures of "Fruits" and "Vegetables" were found to be significantly different over 19 attributes at $P < .001$. This difference was supported through further testing of 3 subsets of variates and direct inspection of raw data mean values. Significant differences for eight

individual attributes were found past the 99% level using simultaneous confidence intervals. "Fruits" were perceived as being included in significantly more breakfasts and desserts; they were significantly sweeter, juicier, and significantly more different from "Beans" than were "Vegetables". "Vegetables" were perceived as being included in significantly more main and side dishes; they were significantly more work to prepare than "Fruits". Figure 18 shows an inventory that describes the perceived relationship between "Fruits" and "Vegetables."

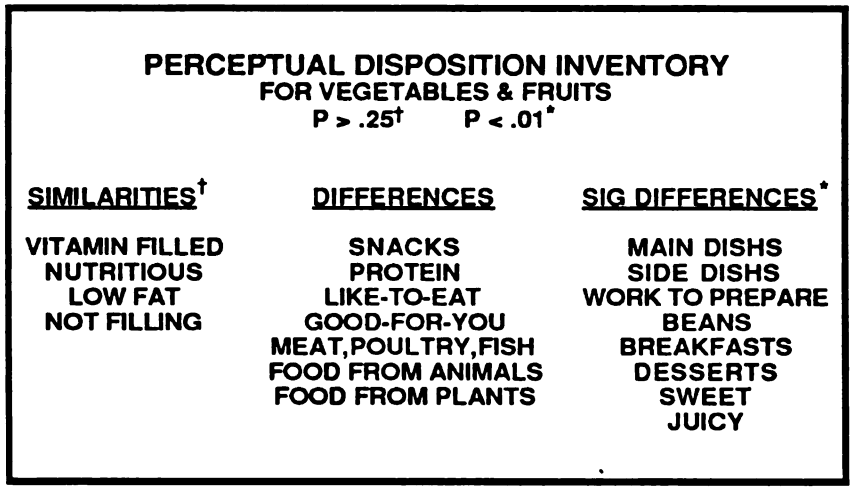

Figure 18. VEGETABLE-FRUIT DIFFERENCE INVENTORY.
This Figure represents an inventory of differences and similarities between "Fruit" and "Vegetable" food grouping constructs.

The construction of the perceptual disposition inventory was based on the following premises. A test that is conservative about ascribing difference is less likely to make Type I errors (Morrison, 1976). SCIs provide a conservative means to find where differences most likely exist. A test that is

generous about ascribing difference is less likely to make Type II errors (Hayes, 1973). Univariate *t*-tests applied to a multivariate situation provide a liberal way of ascribing difference so that the remaining variates are more likely similar. Attribute positions in the inventory indicated by " † " are based on univariate *t*-tests resulting with probabilities of greater than 0.25. Positions indicated by " * " reflect attributes exceeding simultaneous confidence intervals set at $P < .01$. These decision rules increase the probability that attributes listed as significantly different are indeed different, and attributes listed as similar are indeed similar.

HYPOTHESIS 2

2. Ho : Respondents perceive no difference between the constructs "Meat, Poultry, Fish" and "Beans."

Using Hotelling's T^2, perceptual measures of "Meat, Poultry, Fish" and "Beans" were found to be significantly different over 19 attributes. The null hypothesis was rejected at $P < .001$ (Figure 19). As before, three additional Hotelling's tests were conducted to examine if this result could be attributed to different attribute/scale questionnaire subsets. All three subsets were significantly different at the less than .001 probability level (Figure 19). A one-sample univariate *t* -test was conducted on the direct paired comparison between "Meat, Poultry, Fish" and "Beans". The null hypothesis was again rejected at $P < .001$ (Figure 19).

Individual attributes are examined in detail in the figures that follow. SCIs shown in the following series of figures were calculated for the full 19 variates (attributes). Following convention established in the Hypothesis 1 section, individual figures show only 4 to 10 variates at a time to improve readability. These are grouped in the attribute/scale subsets of Figure 19 for convenient viewing.

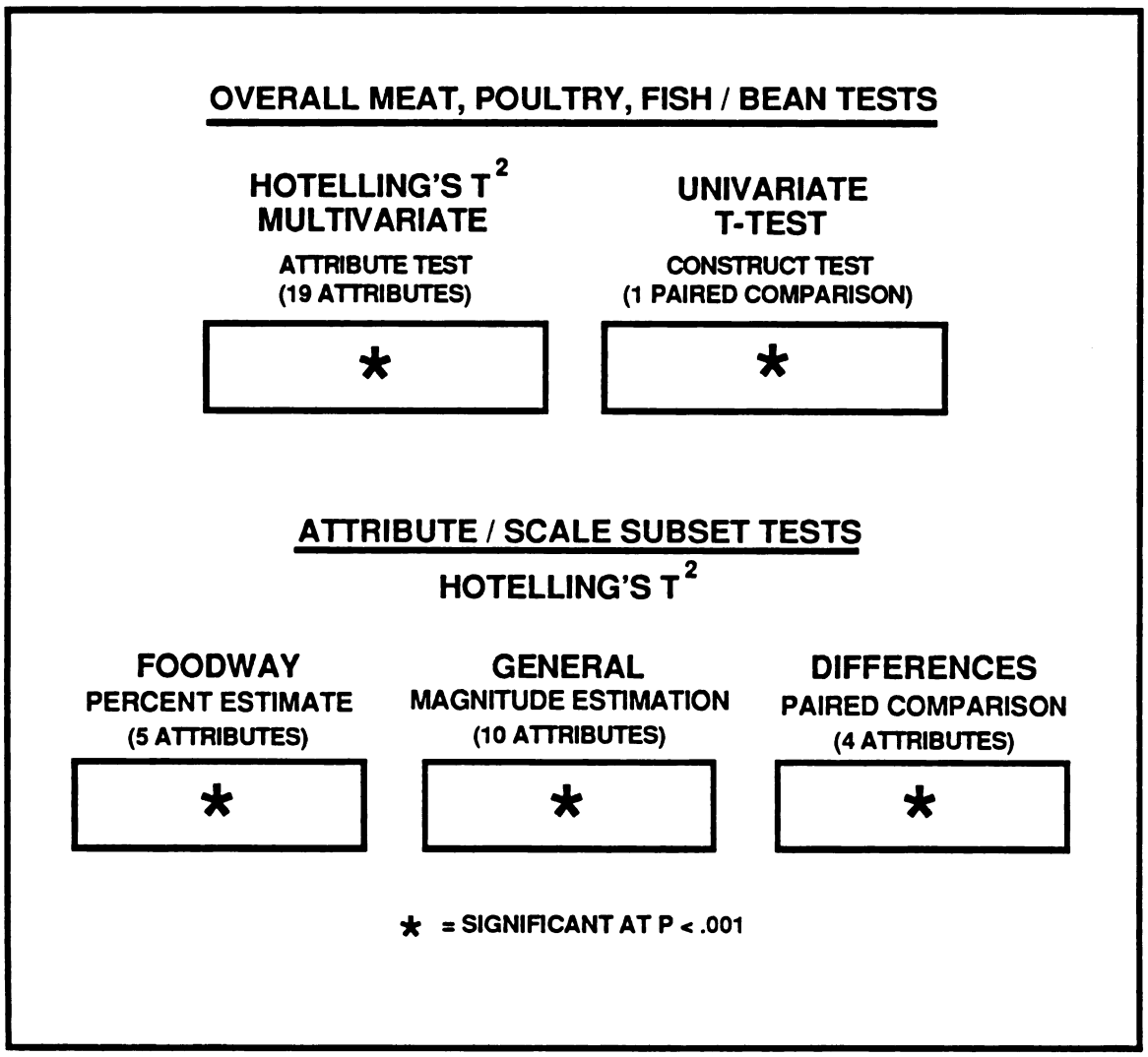

Figure 19. MEAT, POULTRY, FISH / BEAN HYPOTHESIS TEST RESULTS

Meat-Bean Foodway Attributes: Percent Estimate Scale.

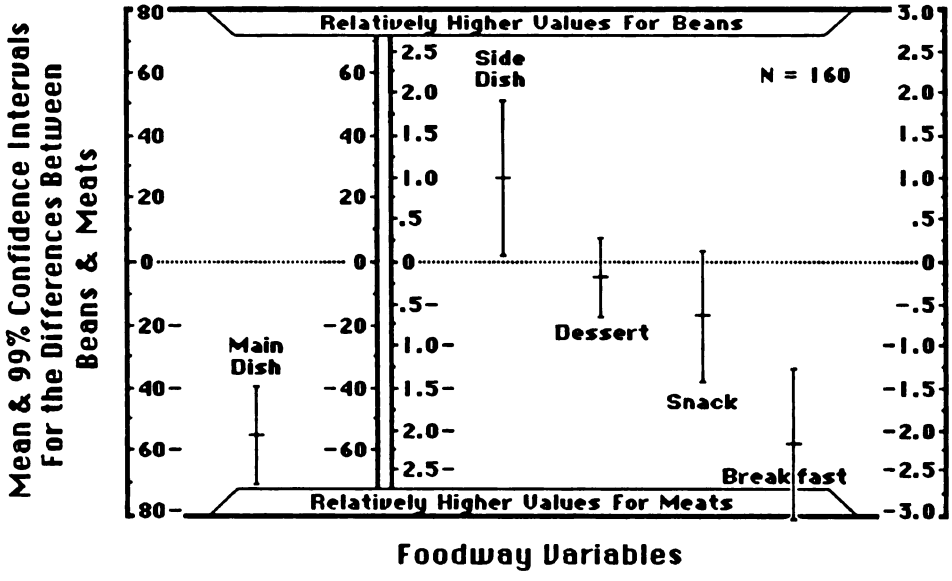

Figure 20. SCIs FOR MEAT-BEAN FOODWAYS.
These are 5 of 19 total simultaneous confidence intervals for raw (left)and transformed (right) difference values between corresponding foodway attributes of "Meats" and "Beans".

Simultaneous confidence intervals for five "Meat" and "Bean" foodway attributes are seen in Figure 20. Each attribute is represented by a vertical confidence interval, crossed at its center, by the mean difference between "Meats" & "Beans." Those attributes whose 99% confidence intervals do not cross the zero line are the best indicators of difference. Attributes whose intervals cross the zero line are not considered different at the 99% confidence level.

Figure 20 shows that the percent of the time that "Meats" were included in main dishes, side dishes, and breakfasts was significantly different from

"Beans." "Meats" were perceived to be included in significantly more main dishes and breakfasts than were "Beans". These results were not unexpected since 32% and 19% of the sample defined a main dish as meat, potato, or fish; and/or as meat, potato, and vegetable respectively. Zero percent defined a main dish as something that had "Beans". These results agree with past researchers who found that "Meats" were perceived as appropriate (Schutz et al., 1972; Schutz et al., 1975) and preferred (Pilgrim and Kamen, 1959) for dinner or as the entree (Pilgrim and Kamen, 1959; Michela and Contento, 1984). They were also perceived as inappropriate for breakfasts, desserts, or snacks (Schutz et al., 1972; Schutz, 1975). The percent of the time that "Meats" and Beans" were included in desserts and snacks in this study, however, did not differ at the 99% confidence level. Evidently, neither were used for desserts and only "Meats" were used as snacks. "Beans" were perceived to be included in significantly more side dishes than "Meats". Figure 21 shows means of raw data values for these same variates.

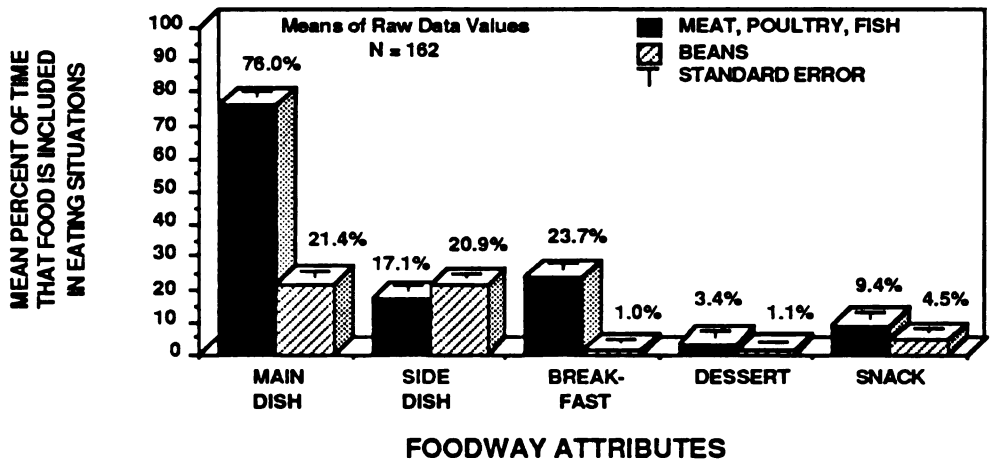

Figure 21. FOOD USES FOR MEATS & BEANS.
These are raw data values for attributes of Figure 20. They show mean percents of behavioral self reports comparing foodway attributes, "Meats" and "Beans."

"Meats" were reported to be included over 20 times more frequently than "Beans" in breakfasts and over 3 times more frequently in main dishes and desserts. "Meats" were perceived to be included in over twice as many snacks as "Beans." Neither "Meats" nor "Beans" were reported to be used much in desserts. "Beans" were not much used in breakfasts, desserts, or snacks. In terms of absolute magnitude, "Meats" were clearly associated with the main dish. They were reportedly included almost 80% of the time.

Meat-Bean General Attributes: Direct Magnitude Estimation Scale.

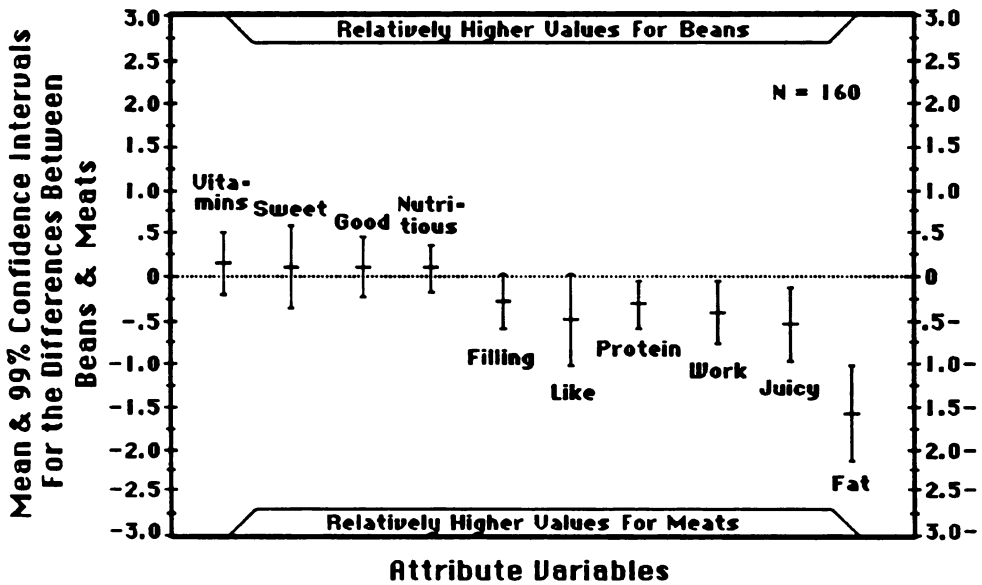

Figure 22. SCIs FOR MEAT-BEAN ATTRIBUTES.
Ten of 19 total simultaneous confidence intervals for transformed difference values between corresponding general attributes of "Meats" and "Beans."

Simultaneous confidence intervals for ten general "Meat" and "Bean" attributes are seen in Figure 22. At the 99% confidence level "Meats" were perceived as having significantly more fat, protein, and juiciness than "Beans." "Meats" were also perceived as being significantly more work to prepare which agreed with Axelson et al.'s (1986) findings where "Meats" were at the inconvenience end of their convenience dimension. Respondents reported liking "Meats" and perceived them as filling. Differences for like-to-eat and filling, however, were not significant at the 99%

confidence level. Other attributes did not appear to be distinctive. Raw data values for attributes are shown in Figures 23 and 24.

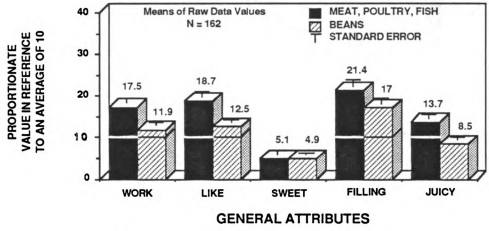

Figure 23. GENERAL ATTRIBUTES OF MEATS & BEANS.
Raw mean magnitudes of "Meats" and "Beans" scaled across attributes of Figure 22. "10" was defined as the "average" value.

Respondents reported "Meats" to be in a three to two ratio over "Beans" in amount of work-to-prepare, how much they liked to eat, and in how juicy. Both were considered above average in amount of work-to-prepare, how much they liked to eat, and in how filling. Both were reported as about half as sweet as average. At the 99% confidence level, "Meats" and "Beans" were not found to be different in sweetness. In a univariate *t* -test, the probability that "Meat" and "Bean" "sweetness" values came from the same population was only .139. This value is too high to signify difference at the alpha level, but it is too low to signify similarity.

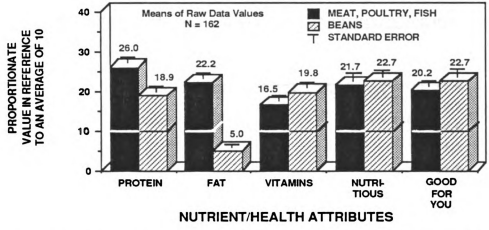

Figure 24. NUTRIENT/HEALTH ATTRIBUTES OF MEATS & BEANS. Raw mean magnitudes of "Meats" and "Beans" scaled across attributes of Figure 22. "10" was provided to respondents as the "average" value.

Figure 24 shows values for nutrient or health-related attributes. Amount of protein and fat were reported as significantly different for "Meats", and "Beans" at the 99% SCI level. "Meats" were reported as having over 4 times the fat and about 25% more protein than "Beans." Both "Meats", and "Beans" were reported as being high in protein. During preliminary investigations, respondents reported consistent differences, however, in the amount and quality of the protein. Both "Meats", and "Beans" were reported as being nutritious, good-for-you, and vitamin filled. None of the three attributes, however, shows probability values that would indicate similarity from univariate *t*-tests. Their respective *t*-test probabilities were .035, .033, and .009.

Meat-Bean Difference Attributes: Ratio Paired Comparison Scaling.

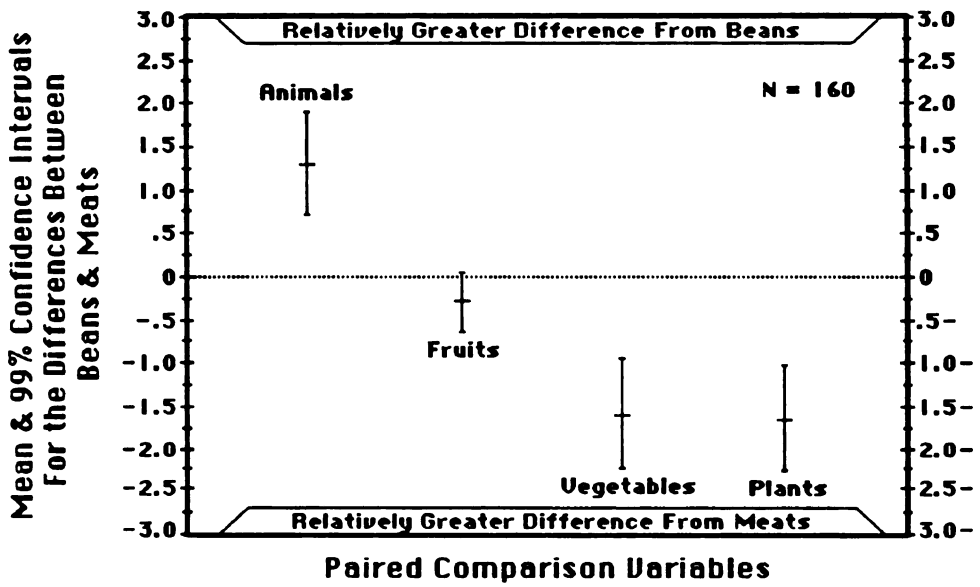

Figure 25. SCI's FOR MEAT-BEAN DIFFERENCES.
These are simultaneous confidence intervals for transformed difference values between four food grouping constructs and "Meats" and "Beans." They represent 4 out of 19 total attributes scaled.

Simultaneous confidence intervals for four difference attributes are seen in Figure 25. Simultaneous confidence intervals calculated from paired comparison data showed that "Food From Animals" as a food grouping construct were perceived as being significantly more different from "Beans" than they were from "Meats." "Foods from Plants", and "Vegetables" were both perceived as being significantly more different from "Meats" than they were from "Beans." "Fruits" were perceived as being more different from "Meats" than "Beans", though not at the 99% confidence level. One major difference between "Meat" and "Bean" perceptions is possibly the difference

between "Foods From Animals" and "Foods From Plants". These results agree with the those reported by Michela and Contento (1984) and Axelson et al. (1986). Both research teams found strong differences between "Meats" and "Beans" along the "Plants" and "Animals" dimensions. "Fruits" were perceived almost as different from "Beans" as they were from "Meats. It can be seen from Figures 25 and 26 that differences were associated with plant and animal source.

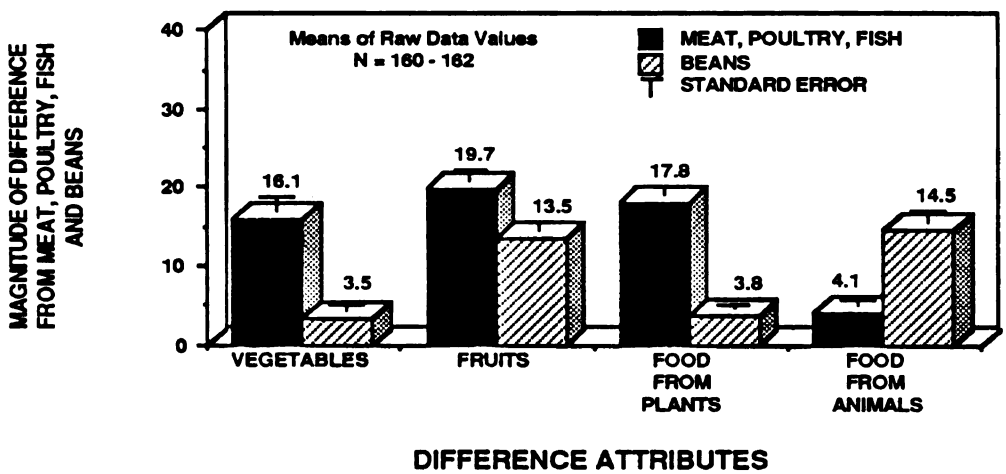

Figure 26. DIFFERENCE VALUES OF MEATS & BEANS.
Raw mean magnitudes of "Meats" and "Beans" scaled directly against four other food grouping constructs (inter-group differences are used as attributes). The difference between "Vegetables" and "Fruits" was defined as 10. All other differences were judged by this criterion pair.

"Meats" were reported as being over 4 times more different from "Vegetables" and "Foods From Plants" than were "Beans." "Beans" were perceived as being one-third as different from "Vegetables" than were "Fruits." "Beans" were reported as being over 3 times more different from "Foods From Animals" than were "Meats." Both "Meat" and "Bean" constructs

were reported as being different from "Fruits." And while "Meats" were found to be about 30% more different from "Fruits" than were"Beans", that difference was not significant at the 99% SCI level (Figure 26).

To determine top-of-mind foods associated with food grouping constructs, respondents were asked to list foods that came to mind after hearing each construct verbalized. Frequencies are recorded in Figures 27 and 28.

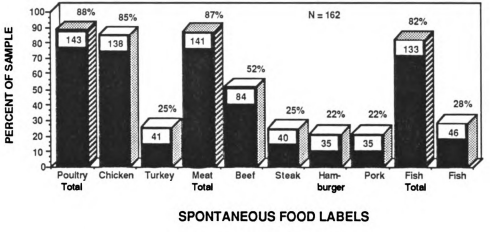

Figure 27. SPONTANEOUS MEAT, POULTRY, FISH RESPONSES
Frequency responses to the question: What foods come to mind when I say "Meat, Poultry, Fish." Actual counts are embedded in columns.

Top of mind "Meat, Poultry, Fish" responses reported most frequently included chicken, beef, and fish (Figure 27). One response was typically given for each of the three categories of meat, poultry, or fish. Top of mind "Bean" responses reported most frequently were green, navy, baked, and, lima (Figure 28). Both fresh and dry beans were mentioned by respondents. While 87% of the sample reported at least one dry bean in their list, the most

frequent response for a single food was for green beans. Frequency data like these may provide an indication of how attributes were judged.

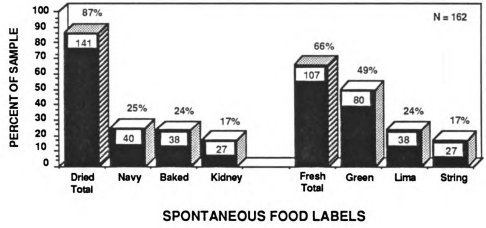

Figure 28. SPONTANEOUS BEAN RESPONSES.
Frequency responses to the question: What foods come to mind when I say "Beans." Actual counts are embedded in columns.

A split-sample reliability test conducted on variables involving the "Meat, Poultry, Fish"-"Bean" data resulted in a coefficient of determination of 1.00. This high measure of reliability demonstrates the consistency with which respondents made their judgments across subsamples.

In conclusion, perceptual measures of "Meats" and "Beans" were found to be significantly different over 19 attributes at $P < .001$. This difference was supported through further testing of 3 subsets of variates and direct inspection of raw data mean values. Significant differences for ten individual attributes were found past the 99% level using simultaneous confidence intervals. These attributes were major contributors to the multivariate

significance. Figure 29 shows a perceptual disposition inventory that describes the relationship between "Meats" and "Beans."

PERCEPTUAL DISPOSITION INVENTORY
FOR MEAT, POULTRY, FISH & BEANS
P > .25† P < .01*

SIMILARITIES†	DIFFERENCES	SIG DIFFERENCES*
	DESSERTS	MAIN DISHS
	SNACKS	SIDE DISHS
	LIKE-TO-EAT	BREAKFASTS
	VITAMIN FILLED	PROTEIN
	NUTRITIOUS	FAT
	GOOD-FOR-YOU	WORK TO PREPARE
	SWEET	JUICY
	FILLING	VEGETABLES
	FRUITS	FOOD FROM ANIMALS
		FOOD FROM PLANTS

Figure 29. MEAT-BEAN DIFFERENCE INVENTORY.
This table represents an inventory of probable differences and similarities between "Meat, Poultry, Fish" and "Bean" food grouping constructs.

HYPOTHESIS 3

1. Ho : Respondents perceive no difference between the constructs "Foods From Animals" and "Foods From Plants."

Using Hotelling's T^2, perceptual measures of "Foods From Animals" (Animals) and "Foods From Plants" (Plants) were found to be significantly different over 19 attributes. The null hypothesis was rejected at the $P < .001$ probability level (Figure 30). As before, three additional Hotelling's tests were conducted to examine if this result could be attributed to different attribute/scale questionnaire subsets. All three subsets were significantly different at the less than .001 probability level (Figure 30). A one-sample univariate *t* -test was conducted on the direct paired comparison between "Meat, Poultry, Fish" and "Beans". The null hypothesis was again rejected at $P < .001$ (Figure 30).

Individual attributes are examined in detail in the figures that follow. SCIs shown in the following series of figures were calculated for the full 19 variates (attributes). Following convention established earlier, individual figures show only 4 to 10 variates at a time. These are grouped in the attribute/scale subsets of Figure 30 for convenient viewing.

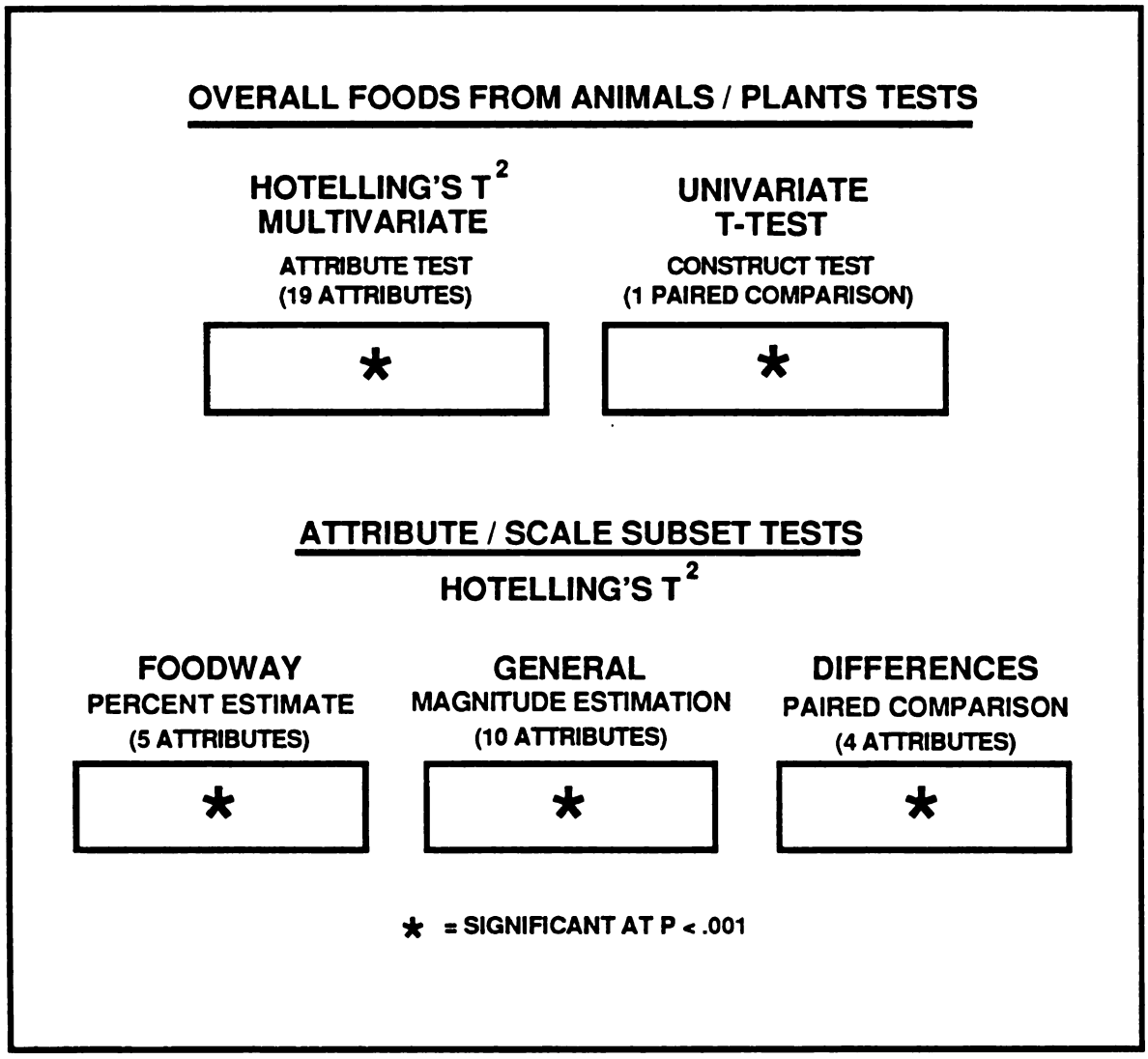

Figure 30. ANIMAL / PLANT HYPOTHESIS TEST RESULTS

Animal-Plant Foodway Attributes: Percent Estimate Scale.

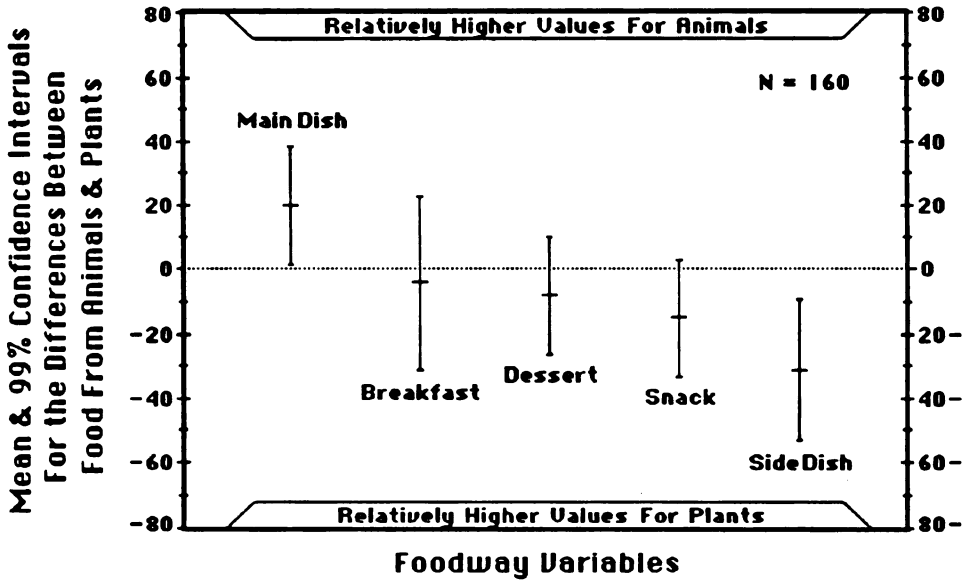

Figure 31. SCIs FOR ANIMAL-PLANT FOODWAYS.
These are simultaneous confidence intervals for transformed difference values between corresponding foodway attributes of "Animals" & "Plants." Represented are 5 of 19 total attributes.

Simultaneous confidence intervals for five "Animal"-"Plant" foodway attributes are seen in Figure 31. According to SCI calculations, "Animals" were perceived to be included in significantly more main dishes than "Plants." "Plants" were perceived to be included in significantly more side dishes than "Animals". Respondents reported including more "Plants" in snacks and desserts, but those values were not significant at the 99% confidence level.

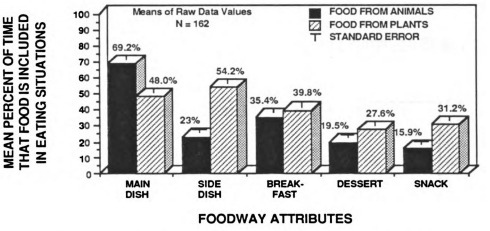

Figure 32. FOOD USES FOR ANIMALS & PLANTS.
These are mean percents of behavioral self reports comparing foodway attributes, "Animals" and "Plants." Represented are 5 of 19 total attributes.

Figure 32 shows means of raw data values for these same variates as Figure 31. "Plants" were reported as included in more side dishes, breakfasts, desserts and snacks than "Animals." "Plants" were perceived to be included in twice as many side dishes and snacks as were "Animals." "Animals" were reported as included in the main dish (7:5 ratio) more often than "Plants." At the 99% confidence level, "Animals" and "Plants" were not different in the percent of the time they were included in breakfast. In a univariate *t*-test, the probability that "Animal" and "Plant" breakfast values came from the same population was .314.

Animal-Plant General Attributes: Direct Magnitude Estimation Scale.

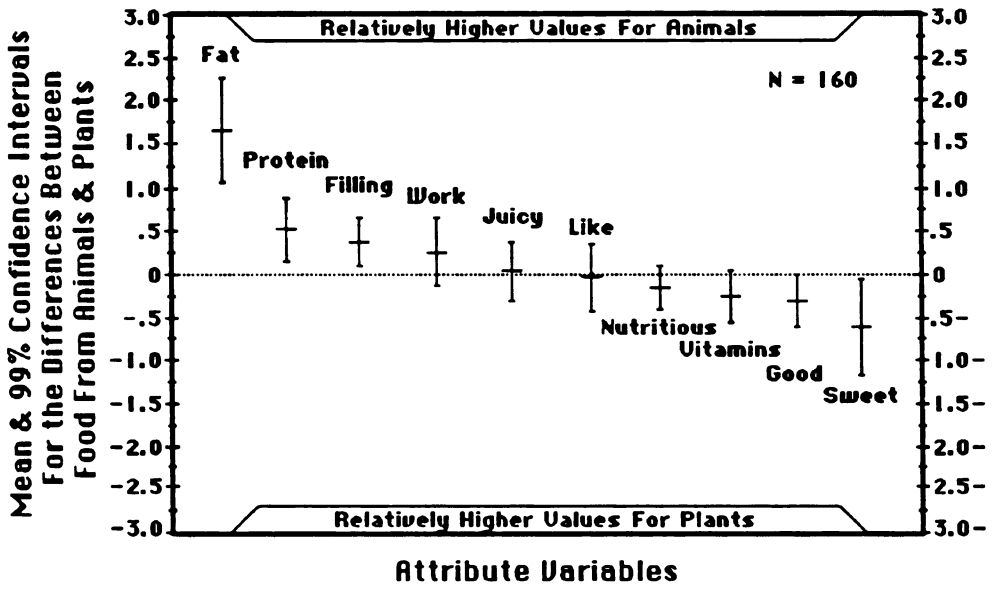

Figure 33. SCIs FOR ANIMAL-PLANT ATTRIBUTES.
These are 10 out of 19 total simultaneous confidence intervals for transformed difference values between corresponding general attributes of "Animals" and "Plants."

Simultaneous confidence intervals for ten general attributes of "Plant" and "Animal" food grouping constructs are seen in Figure 33. At the 99% confidence level "Animals" were perceived as having significantly more fat, protein, and being more filling than "Plants." "Plants" were perceived as significantly more good-for-you and sweet. Differences also existed for perceptions of amount of work, vitamins, and nutritiousness. These differences, however, were not significant at the 99% confidence level.

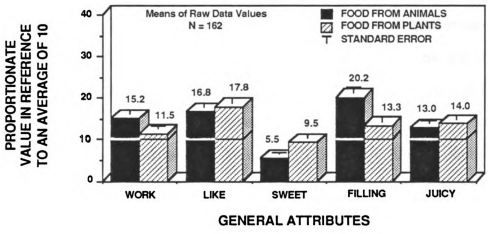

Figure 34. GENERAL ATTRIBUTES OF ANIMALS & PLANTS.
Raw mean magnitudes of "Animals" and "Plants" scaled across attributes of Figure 33. "10" was defined as the "average" value for attributes scaled.

"Animals" were perceived to be more filling (3:2 ratio) and work-to-prepare (4:3 ratio) than "Plants." "Animals", as 'more work-to-prepare', was not consistent with Axelson et al.'s (1986) multidimensional scaling analysis, unless the current sample interpreted "Animals" to mean "Meats". "Meats" were at the "inconvenient" end of Axelson et al.'s convenience dimension (Figure 2). Evidence was collected for the current research regarding what foods came to mind from the stimulus constructs, "Foods From Animals" and "Foods From Plants" (Figure 38). It was found that 96% of responses to the question, "what foods come to mind when I say "Foods From Animals?"" were "Meats" (not seafoods or dairy products) of some sort. From a similar question, "Foods From Plants" were primarily considered "Vegetables" (Figure 39). From observations of respondents verbalizing (thinking out loud) during phone interviews, many expressed difficulty responding to "Animal" -"Plant" questions due to the diversity of foods subsumed by each

category. It is possible that "Plant"-"Animal" results for the current research were a reflection of "Meat" / "Vegetable" differences. Perhaps the mental abbreviations of "Animals" and "Plants" to "Meats" and "Vegetables" respectively, made it easier for consumers to respond.

"Plants", were reported as sweeter (5:3 ratio), juicier, and what respondents liked-to-eat more than "Animals." Both constructs, however, were reported as below average in sweetness. At the 99% confidence level, "Animals" and "Plants" were not different in like-to-eat and juiciness. In a univariate *t*-test, the probabilities that "Animal" and "Plant" like-to-eat and juiciness values came from the same population were respectively, .571 and .384.

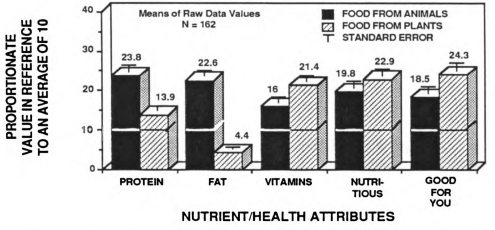

Figure 35. NUTRIENT/HEALTH ATTRIBUTES OF ANIMALS & PLANTS. Raw mean magnitudes of "Animals" and "Plants" scaled across attributes of Figure 33. "10" was defined as the "average" value for attributes scaled.

Figure 35 shows values for nutrient or health-related attributes of "Animals" and "Plants". All values related to nutrients and health were above

average except for "Plants" and their amount of fat. "Animals" were reported as having five times the fat and more protein (5:3 ratio) than "Plants." "Plants" were reported as being more good-for-you (5:4 ratio), vitamin filled (4:3 ratio), and nutritious than "Animals."

Animal-Plant Difference Attributes: Ratio Paired Comparison Scaling.

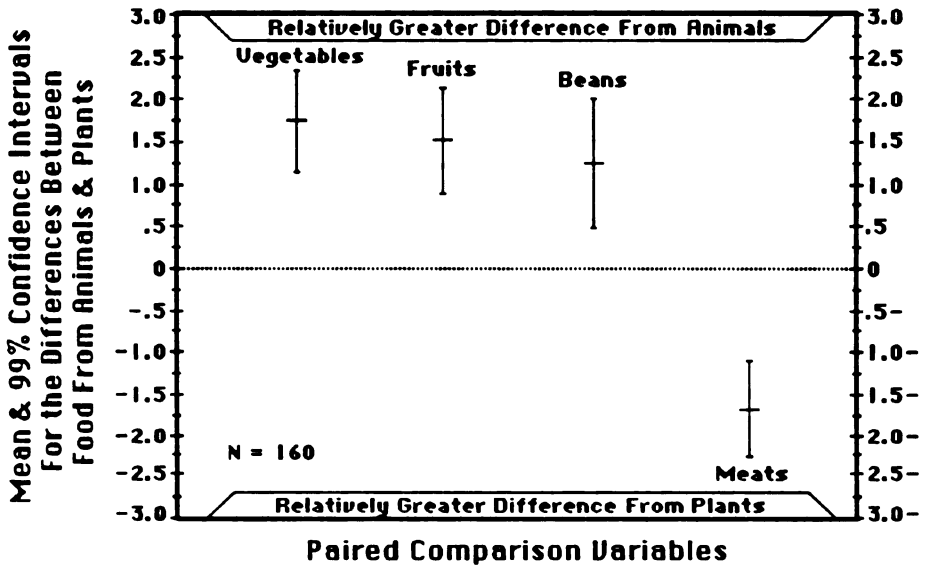

Figure 36. SCIs FOR ANIMAL-PLANT DIFFERENCES.
These are simultaneous confidence intervals for transformed difference values between four food grouping constructs and "Animals" and "Plants." They represent 4 out of 19 total attributes scaled.

Simultaneous confidence intervals for four "Animal" - "Plant" difference attributes are seen in Figure 36. According to simultaneous confidence intervals calculations, all attributes from "Animal"-"Plant" paired comparison data were significantly different at $P < .001$. "Animals" as a food grouping

construct were significantly more different from "Vegetables", "Fruits", and "Beans" than were "Plants." "Plants" as a food grouping construct were significantly more different from "Meats" than were "Animals." These results are consistent with the "Animal" - "Plant" dimensions uncovered by both Axelson et al. (1986) and Michela and Contento (1984). All food grouping constructs tested clearly fell along plant and animal lines.

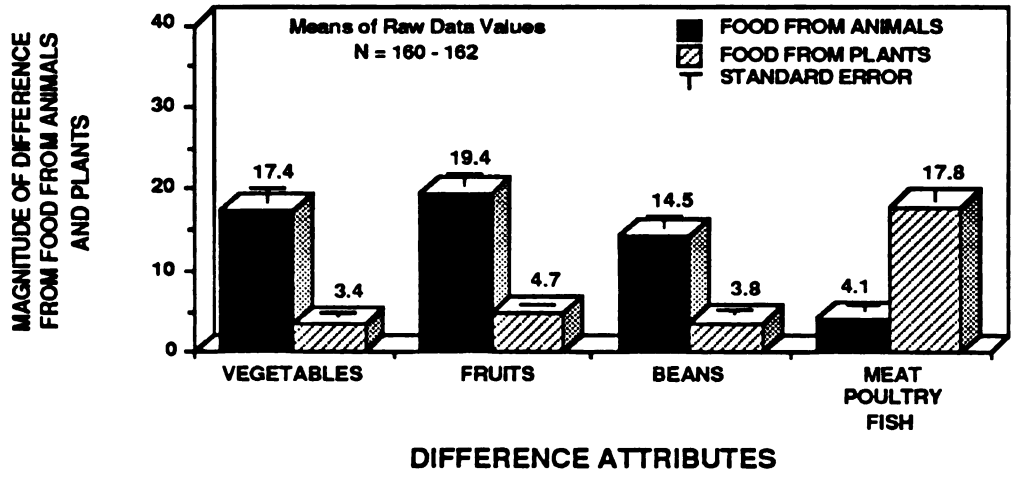

Figure 37. DIFFERENCE VALUES OF ANIMALS & PLANTS.
Raw mean magnitudes of "Animals" and "Plants" scaled directly against four other food grouping constructs (inter-group differences are used as attributes). The difference between "Vegetables" and "Fruits" was defined as 10 on this scale. All other differences were judged by this criterion pair.

"Animals" were reported as being over 5 times more different from "Vegetables", 4 times more different from "Fruits", and 3 times more different from "Beans" than were "Plants." "Plants" were perceived as being three times more different from "Meats" than were "Animals." Again all these differences were significant at the 99% confidence level and followed a logical animal-plant source breakdown.

To determine top-of-mind foods associated with food grouping constructs, respondents were asked to list foods that came to mind after hearing each construct verbalized. Frequency responses are reported in Figures 38 and 39.

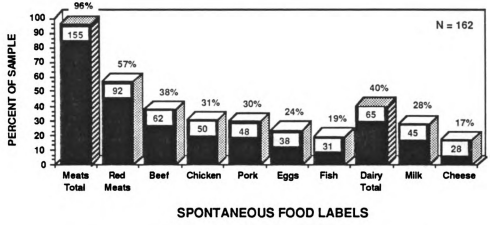

Figure 38. SPONTANEOUS ANIMAL RESPONSES
Frequency responses to the question: What foods come to mind when I say "Foods from Animals." Actual counts are embedded in columns.

Top of mind "Foods From Animals" responses reported most frequently included red meat, beef, chicken, pork, milk, eggs, and fish (Figure 38). Meats of any kind were included in 96% of the responses. Dairy foods were included only 40% of the time. Few dairy foods were mentioned besides milk and cheese.

Top of mind "Foods From Plants" responses reported most frequently were "Vegetables", tomatos, "Fruits", lettuce, "Beans", and corn (Figure 39). General categories like "Vegetables", "Fruits", and "Beans" were mentioned

along with specific "Vegetables", like tomatos[1] and lettuce. One possible explanation for the types of foods reported is that the stimulus "Foods From Plants" brings to mind things grown on plants in a garden. Gardens may be the only place some people come to associate plants with the foods they eat.

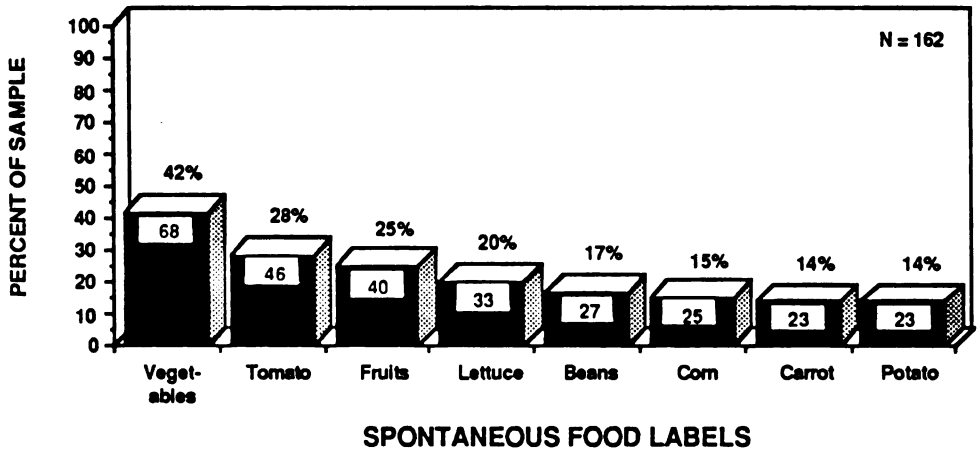

Figure 39. SPONTANEOUS PLANT RESPONSES.
Frequency responses to the question: What foods come to mind when I say "Foods From Plants." Actual counts are embedded in columns.

A split-sample reliability test conducted on variables involving the "Animal"-"Plant" data resulted in a coefficient of determination of 0.88. This high measure of reliability demonstrates the consistency with which respondents made their judgments across subsamples. Due to the general nature of these constructs, however, the reliability was down from "Fruit" -

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1 Tomatos are commonly known as vegetables. Evidence supporting that fact was found in this research and reported in Figures 14, and 15. It is acknowledged that botanically speaking tomatos and many other "vegetables" are considered fruits.

"Vegetable" and "Meat" - "Bean" comparisons.

In conclusion, perceptual measures of "Animals" and "Plants" were found to be significantly different over 19 attributes at $P < .001$. This difference was supported through further testing of 3 subsets of variates and direct inspection of raw data mean values. Significant differences for ten individual attributes were found past the 99% level using simultaneous confidence intervals. These attributes were major contributors to the multivariate significance. Figure 40 shows an inventory that describes the perceived relationship between "Animals" and "Plants."

PERCEPTUAL DISPOSITION INVENTORY
FOR FOOD FROM ANIMALS & PLANTS
$P > .25^{\dagger}$ $P < .01^{*}$

SIMILARITIES†	DIFFERENCES	SIG DIFFERENCES*
LIKE-TO-EAT	DESSERTS	MAIN DISHS
JUICY	SNACKS	SIDE DISHS
BREAKFASTS	WORK TO PREPARE	PROTEIN
	VITAMIN FILLED	FAT
	NUTRITIOUS	GOOD-FOR-YOU
	FILLING	SWEET
		VEGETABLES
		FRUITS
		BEANS
		MEAT,POULTRY,FISH

Figure 40. ANIMAL-PLANT DIFFERENCE INVENTORY.
This table represents an inventory of probable differences and similarities between "Foods From Animals" and "Foods From Plants" food grouping constructs.

Summary of Results

The null outcome was rejected for all three hypotheses at the .001 probability level. Food group construct pairs ("Fruits" and "Vegetables"; "Beans" and "Meat, Poultry, Fish"; and "Foods From Animals" and "Foods From Plants"), as operationalized, were perceived as significantly different by respondents. This was true for univariate tests of paired comparison data and Hotelling's multivariate tests on a series of 19 attributes. Investigations were undertaken to identify which of the attributes contributed to the multivariate significance.

"Vegetables" and "Fruits" were significantly different in several ways (Figure 18). Vegetables were perceived as being included in significantly more main and side dishes than "Fruits". "Vegetables" were perceived to be significantly more work to prepare than "Fruits". "Fruits", on the other hand, were perceived as being included in significantly more breakfasts and desserts than "Vegetables". They were perceived as significantly sweeter and juicier. And they were perceived as being significantly more different from "Beans" than "Vegetables". Other differences were found but not at the 99% confidence level. Four "Vegetable"-"Fruit" attributes demonstrated some similarity: amount of vitamins, fat, nutritiousness, and filling.

"Meat, Poultry, Fish" and "Beans" were significantly different in a number of ways (Figure 29). "Meats" were perceived to be included in significantly more main dishes and breakfasts than "Beans". "Meats" were perceived to have significantly more fat, protein, and juiciness, and took significantly more work to prepare than "Beans". "Meats" were perceived as being more

different from "Vegetables" and "Plants" than were "Beans". "Beans", on the other hand, were perceived as being included in significantly more side dishes than "Meats". And "Beans" were perceived as being more different from "Animals" than "Meats". Other differences were found but not at the 99% confidence level. No attributes demonstrated similarity.

"Foods From Animals" and "Foods From Plants" were significantly different in several ways (Figure 40). "Animals" were perceived to be included in significantly more main dishes than "Plants". "Animals" were perceived to have significantly more fat, protein, and filling than "Plants". "Animals" were perceived as being more different from "Vegetables", "Fruits", and "Beans" than were "Plants". "Plants", on the other hand, were perceived as being included in significantly more side dishes than "Animals". And, "Plants" were perceived as being significantly more different from "Meats" than "Animals". Other differences were found but not at the 99% confidence level. Three attributes demonstrated moderate similarity: juicy, like-to-eat, and inclusion in breakfast.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This chapter presents strengths, limitations, and conclusions of the present study as well as implications and recommendations for future research. The goal of this study was to test certain food grouping constructs for difference according to perceptions of consumers. Strengths and limitations are presented first so that the conclusions can be considered within their context.

Strengths, Limitations, and Other Considerations

One strength of this research is that the sample used is more representative of the general population than those of previous studies. Education, occupation, income, and ages represented diverse segments of the society. This sample, however, deviated from the general population in that it represented a higher proportion of females, slightly higher income, and overall higher educational attainment. This sample did not represent households without phones, persons who do not spend time at home, persons who do not answer phones, or persons who refused to participate. The poor and uneducated are not well represented in this sample. Generalization of results to them should be met with caution.

Science progresses in steps. This is only one study on one particular sample of consumers from Mid-Michigan. The repetition of results over a

variety of samples and research designs will help determine how representative this particular sample is regarding peoples' perceptions of food grouping constructs. This study asked questions of specific food grouping constructs, but other considerations are involved in the study of consumer perceptions. Respondents in this study were constrained to react to the constructs used as stimuli. Consumers may have different conceptualizations and labels for classes of foods than the constructs used. Consumers may have more than one classification system for the same foods under different circumstances. In addition, attributes and perceptions regarding food grouping conceptions may change over time. While these issues were not the direct concern of this dissertation, they represent issues that complicate the generalizability of conclusions based on the food grouping constructs used in this research.

This dissertation was the first to operationally define food grouping constructs. What is not defined cannot be measured. This has been one limitation of past research. This operationalization has provided a functional formulation for this work and could provide a focus for future research. Because this project was the source of the operational definition, it was also the first in which differences between food grouping constructs were tested. This research should provide nutrition educators, for the first time, with information about the constructs that have been used and unstudied since the original publication of the Basic Four Food Groups in 1957 (Page and Phipard, 1957).

One issue debated by this researcher related to the use of the construct "Meats" vs the construct "Meat, Poultry, Fish." "Meat, Poultry, Fish" was

chosen because it represented the exact wording used by the Daily Food Guide once "Beans" were extracted. This label, however, is not typically how persons refer to "Meats", a seemingly more common referent for this class of foods. It is assumed that respondents would have more difficulty responding to "Meat, Poultry, Fish" than they would to "Meats." This may affect the reliability of responses for "Meat, Poultry, Fish" questions because respondents may be reacting to "Meat", "Poultry", "Fish", or any combination of the three.

During preliminary research, attributes were generated from contrasts between "Fruits" and "Vegetables" and between "Meats" and "Beans". Attributes generated from these contrasts were used for the scaling of all six constructs. Attributes were not generated from direct contrasts between "Foods From Animals" and "Foods From Plants". "Foods From Animals" and "Foods From Plants" represent a higher level of organization than "Meats", Vegetables", and the like. Consequently the attributes that describe "Foods From Animals" and "Foods From Plants" may not be the same as those that describe "Meats", Vegetables", and the like. This was a limitation in the research design that may have affected responses to "Foods From Animal" and "Foods From Plant" questionnaire items.

Of the three one-sample univariate *t* -tests possible, the test between "Vegetables" and "Fruits" was not conducted. Of all constructs compared in preliminary research, the difference between "Vegetables" and "Fruits" demonstrated properties of the best criterion by which other constructs should be judged (Woelfel and Fink, 1980). Since the difference between

"Vegetables" and "Fruits" served as this criterion-pair, a test of a set value would be an inappropriate hypothesis test.

There is a fundamental problem in a survey questionnaire which consistently refers to constructs separately that may be considered as similar. For instance, the survey asked questions about "Fruits" and about "Vegetables". Had there been questions about "Vegetable-Fruits" or "Fruit-Vegetables" perhaps they would have been perceived by respondents as less different. It is not known to what extent constructs were different due to the fact that they occurred consistently as different stimuli within the questionnaire.

This research is based on attributes derived directly from consumers during preliminary research investigations. Natural language terms were identified and used whenever possible to represent those attributes. These terms were assumed to have more meaning to respondents than those created by researchers. A major limitation of past studies was a tendency to rely solely on the intuition and perspective of the researcher to determine what attributes consumers would use to judge foods. In traditional food guidance, food grouping constructs were not based (in an empirical sense) on the natural language of consumers.

Attributes used in the analyses were a function of consumers' ability to verbalize them. One example of an important attribute that was not well verbalized by respondents of the preliminary research was a "Plant" - "Animal" distinction. This dimension, however, was clearly indicated by past research (Axelson et al., 1986; Michela and Contento, 1984) as well as in the results of this study. This verbalization problem indicates the importance

of using a variety of techniques and research designs to investigate problems of perception.

During the initial attribute generation process, respondents were not provided with any contexts by which to judge food construct similarities or differences. They were simply asked, for example, "How are "Fruits" and "Vegetables" different?". Sensory attributes may dominate response sets at the expense of more situational ones. In the course of everyday life, food patterns, practices, and trade-offs occur within some environmental, or sociocultural context. One would expect less attributes concerning life-style, cost, emotions, and the like to be mentioned in the context of a survey; this may have narrowed the scope of responses to more context-free attributes.

Respondents were asked to define attributes that were scaled within the telephone survey questionnaire. Definition questions are time consuming and induce fatigue in respondents. In an attempt to restrict the time and energy required during phone interviews, respondents were not asked to define all 19 attributes of the study. This is not an optimal situation, however, because some attributes may not mean what we might think. For instance, if a nutritionist were asked how much "fat" is there in potatoes, the answer would be low because potatoes themselves are low in lipids (fat). If a consumer were asked the same question, the answer might be high because potatoes have carbohydrates (calories), or because the consumer always eats potatoes with sour cream or butter. Filling, high lipid, high calorie, or the way a food is eaten may influence how a consumer determines how much fat there is in a food. Without a consumer definition of all the scaled attributes, conclusions about results are limited. This is not to say that consumers

would provide perfect definitions if given the chance. It only means that the researcher would have a better indication of what and how stimuli are processed for responses.

All attributes were measured on ratio scales. Ratio scales are considered the most useful type of measurement scale employed in science (Torgerson, 1958), and the oldest and most basic form of measurement (Stevens, 1974). They are recommended over ordinal methods for psychometrics (Stevens, 1957), and their application to problems of social significance have been clearly demonstrated (Gescheider, 1985). One value of ratio scales is found in the property of magnitude. A true zero point exists and when one value is more than another, you can tell just how much more. This kind of sensitivity is important where a precise science is valued. Since ratio values are based on real numbers, all forms of mathematical transformations are possible, and the measurement assumptions of the most advanced forms of data analysis are met.

A convenience sample was used for preliminary investigations. These were mall shoppers from a Mid-Michigan suburb. This sample was used for attribute generation and the determination of a metric ruler for paired comparison measures. It is not known to what extent non-randomness affected the list of attributes generated.

Conclusions

All objectives of this dissertation were met. An operational definition of a food grouping construct was devised. An initial sample of respondents was queried to determine attributes that characterized the similarities and

differences of food grouping constructs. Consumer perceptions of inter-construct differences and attributes associated with them were scaled at the ratio level. Univariate and multivariate *t* -tests were conducted to determine if selected food grouping constructs, grouped together in the Basic Four Food Groups, were equivalent. The Daily Food Guide version of the Basic Four was used as the source of the exact wording of constructs. And finally, individual attributes were examined for differences to determine the cause of the multivariate significance.

As predicted, all hypotheses were rejected at $P < .001$ in both direct testing of constructs themselves and direct testing of attributes associated with those constructs. Several conclusions regarding peoples' perceptions of food grouping constructs emerged from the preceding analyses. These conclusions must be interpreted in light of the limitations concerning generalizability expressed in the last section.

First, consumer perceptions of food grouping constructs do not appear to support those of the Basic Four Food Groups as represented by the Daily Food Guide. Consumers make distinctions greater than outlined in only four groups. Open sorting tasks indicated consumers make between 5 and 8 groupings, depending on the complexity of the stimulus foods. Hypothesis tests confirmed some of those groupings. The generality of this first conclusion should be tempered by the fact that only two of the four groups of the Basic Four were investigated.

Second, if the goal of the design of food guidance is to match consumer perceptions, hypothesis test results indicate initial support for the grouping organization of the EFNEP's Food Choices for Variety (Figure 1). This

support is qualified because only four of the six constructs of the EFNEP's Food Planner were tested in this dissertation. And while the separation of "Meats" and "Beans" was supported by hypothesis tests, it should be recognized that "Beans" represent a different level of organization than "Meats" to consumers. Many participants of this study expressed confusion that "Beans" rated "group" status. "Beans", for the most part, were recognized as "Vegetables". One reason for giving "Beans" "group" status is to emphasize certain "Beans" as alternative sources of protein. This emphasis does not, however, reflect current consumer perceptions of "Beans". According to consumer perceptions, if "Beans" do not rate as an independent group, they should be placed in with "Vegetables" and not with "Meats".

Third, "Beans" and "Meats" should probably not be included in the same group if the goal is to match consumer perceptions. This is true for several reasons, some of which are repeated from the above paragraph. According to univariate and multivariate hypothesis tests, "Beans" were not equivalent to "Meats". "Beans" were repeatedly associated with or defined as "Vegetables". "Beans" were perceived more as "Foods From Plants" while "Meats" were perceived more as "Foods From Animals". "Meats" and "Beans" were both perceived as being higher than average in protein. The protein in "Meats", however, was perceived to be significantly higher in quantity than in "Beans". "Meats" and "Beans" were found to be significantly different in 10 of 19 total attributes. None of the attributes demonstrated similarity.

Fourth, "Fruits" and "Vegetables" should probably not be included in the same group if the goal is to match consumer perceptions. This is true for the following reasons. According to univariate and multivariate hypothesis tests, "Fruits" were not equivalent to "Vegetables". According to undirected sorting tasks, "Fruits" and "Vegetables" were, for the most part, placed in separate piles. According to measures of food use, "Fruits" and "Vegetables" were used in very different eating situations. "Fruits" were associated with desserts, snacks and breakfast, while "Vegetables" were associated with main and side dishes of meals. "Vegetables" and "Fruits" were found to be significantly different in 8 of 19 total attributes. Perceptual measures on four attributes were not different. Three of those four "similar" attributes were: vitamin filled, nutritious, and low fat. These three were considered abstract because they are not learned through concrete experience; they are taken on faith. These "similar" attributes also describe foods and food groups other than "Fruits" or "Vegetables".

Fifth, "Foods From Animals" and "Foods From Plants" should probably not be mixed within groups if the goal is to match consumer perceptions. This is true for the following reasons. According to univariate and multivariate hypothesis tests, "Foods From Animals" were not perceived as equivalent to "Foods From Plants". According to undirected listing tasks, "Foods From Animals" and "Foods From Plants" were described by different foods. "Foods From Plants" and "Foods From Animals" were found to be significantly different in 10 of 19 total attributes. Only three attributes demonstrated similarity. From previous research "Foods From Animals" and

"Foods From Plants" were clearly demonstrated to be on opposite ends of dimensions in two separate multidimensional scaling solutions.

Finally, the extent to which these conclusions apply to different food guidance systems depends on the intended use of the food guidance system. If the goal is to change perceptions regarding how people group foods, then these results can serve as a guide on where to begin making changes. If the goal is to build or anchor new information on existing perceptions, then these results provide baseline conceptions upon which to formulate structure.

This study tested if traditional groupings represented consumers perceptions. It did not test the effectiveness of different food groups on learning. All else being equal, it might be inferred that food planning and nutrition information based on groupings that reflect consumer perceptions would serve as more effective nutrition education devices than those that do not reflect consumer perceptions. Effectiveness, however, was not demonstrated behaviorally in this research unless one defines effectiveness as the degree to which food grouping constructs reflect consumer perceptions.

Implications

Nutrition educators have always intended to accommodate consumer learning predispositions to various degrees. The application of this intent, however, rarely went beyond the idea of simplicity. Simplicity is used here to mean the summarizing or reduction of information in a way that made sense to the classifier. Only recently have researchers begun the empirical

examination of consumers' predispositions. Perceptions regarding individual foods were examined, according to attributes that made sense to researchers. They used techniques that would reveal the "underlying meaning" of foods. The resulting information gained was in the area of factors describing how foods or attributes were related. Basically two things were demonstrated. First, foods were multidimensional concepts whose semantic meanings went beyond knowledge of nutrient composition. Second, certain foods were systematically related to other foods or certain attributes.

The present study goes beyond past research efforts in the following ways. First, this research changed the unit of analysis from individual foods to food groups themselves. While valuable information can be gained from individual foods, it is the group itself that is presented in food guidance. It is the group to which information about nutrition, serving size, serving number, and meal planning are attached. Therefore, it is the group that should be the primary focus of research on consumer perceptions of groups. Second, food grouping constructs and concepts were operationally defined. This allows researchers to begin the systematic examination of groups in a way that can transfer from study to study. Third, through its hypotheses, this research challenged assumptions upon which traditional food guidance was based. Those assumptions regarded the "simplicity" of food grouping constructs used by developers of the Basic Four Food Groups. Often times scientific advances do not occur until the "standard" has been critically examined and debate ensues. Fourth, specific hypotheses were proposed and tested regarding specific food grouping constructs. Until the present research there

was scattered evidence to indicate how "Vegetables", "Fruits", "Meats", "Bean", "Animal", and "Plant" constructs were perceived by consumers. Specific testable questions regarding group membership were not asked. Specific tests conducted here have given specific answers to specific questions. And finally, precise, highly reliable results were obtained from the ratio scaling of perceptions. Previous research had limited itself to ordinal scaling techniques. Not only did the scales used in the current research meet the measurement assumption of the multivariate *t* - test, they provided a meaningful way to examine the data. For the first time it could be determined exactly how much more protein, for example, "Meats" were perceived to have relative to the "average", or relative to "Beans", or relative to any other food concept measured on this scale. Another advantage of this level of measurement involves the power of the real number system that it produces. All mathematical operations that can be used with the real number system are then available to researchers wishing to develop formulas and laws to explain or predict phenomena. All of these advances provide a new frontier for scientists to investigate.

Both the research approaches taken and the results obtained extend the body of knowledge of nutrition education. The research demonstrates that food grouping constructs can be defined, attributes that describe them can be measured and tested for difference, and conclusions can be drawn regarding the tested differences.

This research demonstrated that the audience perspective can differ markedly from that which might be assumed by professionals. Audience input regarding nutrition education has demonstrated its importance merely

by being different from the standard nutrition perspective. Without further research we have no idea if or how these differences will affect the consumers ability to learn the information we are attempting to convey. Audience importance is not limited to nutrition education researchers. Nutrition education practitioners must also take their audiences into account for any nutrition education event.

If nutrition practitioners are to incorporate results from this study into food guidance, they might rethink the use of current food guidance devices and support materials. They might make specific recommendations for "Fruits" separate from "Vegetables" within the context of the ways the foods are commonly used. In light of the differences found between food grouping constructs practitioners might take more care to analyze their audiences whenever possible to determine how well their nutrition education program reflects audience perceptions.

Guides that distinguish between "Foods From Animals" and "Foods From Plants" will provide new opportunities for practitioners to teach concepts related to the dietary guidelines. For instance dietary fiber, cholesterol, and fat, show patterns that coincide with "Plant" and "Animal" distinctions.

The EFNEP Food Planner is already being distributed nationally. Several of its components reflect consumer perceptions more accurately than the Basic Four Food Groups; however, several other components remain uninvestigated. As such, it should undergo more scientific scrutiny in terms of its overall appropriateness.

If the assumption is made that consumers will learn more about nutrition and meal planning from food guidance materials that reflect their food

grouping preconceptions, it follows that more informed consumers become enabled to make more prudent food choices. Acting on that enablement is the next step. If consumers are inclined to follow food guidance recommendations, in the first place, they are more likely to follow something that makes sense to them.

Recommendations for Future Research

This section offers recommendations for research that might be conducted to further advance the study of consumer perceptions of food grouping constructs. The first set of recommendations concern the representativeness of the sample. Large scale studies could be conducted covering the whole United States, the continental United States or other specified regions of the country. The goal could be to replicate this study or to build on it by asking questions related to other food grouping constructs.

In this research the 19 attributes used were treated equally in the testing scheme for all three construct comparisons. Certain attributes may be salient when contrasting certain food grouping constructs; others may not. A theory needs to be developed to determine how such decisions might be made. It is likely that some attributes will have no relevance to either of two food grouping constructs. In this case where an attribute is equally irrelevant to two constructs, a *t* -test may result in the acceptance of the null hypothesis. But in this case the null hypothesis may be accepted on the basis of an irrelevant feature rather than because of a relevant feature that they both have in common. Common and irrelevant features may have identical results in the *t* -testing situation. Related to this issue is the matter of defining

attributes. That is, are there one or two attributes that define a group? For instance, are apples, peaches, and strawberries "Fruits" by virtue of the fact that they are sweet and juicy? If fruits were not sweet would they, by default, be "Vegetables"? Non-sweet fruits are commonly classified as "Vegetables". Zucchini, green pepper, and squash are "Fruits", botanically speaking, but they are not sweet.

Another question is, what role does the context of a situation play in the generation and testing of attributes? Are "Fruits" and "Vegetables" different because attributes were generated in the context of a shopping mall, or because interviews were conducted on the telephone? Would different attributes be generated during shopping or cooking? Would scaled responses be different if they were requested during grocery shopping or cooking? Are there classes of attributes that can be expected to occur under different contexts?

A question only touched on by preliminary research here relates to the lexical set which best describes consumers' natural food groupings. That is, in addition to asking what groups best reflect consumers' perceptions, also ask about the labels that best describe those groups? How are lexical sets manifested? It may be that no matter how creatively you describe the "Meat, Poultry, Fish, Egg" group, consumers may remember them simply as "Meats". Is this outcome acceptable for the goals of the nutrition education device? Another question is what audience-specific lexical sets exist for groups at nutritional risk? And finally, what is the lexical set for the national audience?

Is it feasible or desirable to design a food guidance system based solely on consumer perceptions? If groups, group labels and salient attributes are

generated directly from respondents, will a design for a guide emerge directly out of the patterns and labels in the data?

Summary

In brief summary, this study was a test for difference between three sets of food grouping constructs. Those constructs were "Fruits" and "Vegetables"; "Meat, Poultry, Fish" and "Beans"; and "Foods From Animals" and "Foods From Plants". This was a fairly representative, single sample study of peoples' perceptions of food grouping constructs. Attributes were generated from natural language descriptors used by a convenience sample. Multivariate *t* -tests were conducted for all three sets of food grouping constructs. Univariate *t* -tests were conducted for two sets of food grouping constructs. As predicted, all hypotheses were rejected at $P < .001$ for overall measures of difference. Within the limitations expressed earlier, results did not support the food grouping constructs of the Basic Four Food Groups as represented by the Daily Food Guide. Results did support the food grouping constructs of the EFNEP Food Planner. Conclusions were that "Fruits" and "Vegetables"; "Meat, Poultry, Fish" and "Beans"; and "Foods From Animals" and "Foods From Plants" should not be included in the same groups if the goal of grouping is to match consumer perceptions. This study did not test the effectiveness of different food grouping constructs on learning.

The present study goes beyond past research in that food groups themselves were the unit of study rather than individual foods. Food grouping constructs were operationally defined. The hypotheses were

designed to challenge long standing assumptions about how consumers perceive food groups. Ratio scales were used for the measurement of attributes.

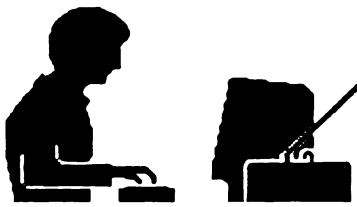
Recommendations for future research include the following: Conduct repeat and larger studies on a variety of samples to confirm, refute, or elaborate on findings reported here. Determine some theory or model to limit the number of attributes to only those that are salient or defining to the constructs of interest. Examine the role that context plays in the generation of attributes as well as their scaling. What lexical set(s) best describe(s) how consumers would group foods themselves. And finally, is it feasible to design a food guidance system based solely on consumer perceptions.

APPENDICES

APPENDIX A

RESEARCH INVOLVING HUMAN SUBJECTS

Appendix A contains two letters involving approval to conduct research on human subjects. The first letter is a request for human subject research approval and contains an additional two page UCRIHS proposal. The second is the approval from the Michigan State University Committee on Research Involving Human Subjects (UCRIHS).



JOHN N. KALLAS
MICHIGAN STATE UNIVERSITY
FOOD SCIENCE & HUMAN NUTRITION
1, HUMAN ECOLOGY BUILDING
EAST LANSING, MI, 48824
OFFICE: (517) 353-4357
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October 17, 1985

RE: UCHRIS Review

Dear Dr. Bredeck,

I am a doctoral candidate in the Department of Food Science and Human Nutrition. Please find attached, the materials required for UCHRIS review. This UCHRIS review is for my dissertation research.

Please exempt this proposal from the full review process: Category "C". This research involves survey procedures that maintain the anonymity of respondents. It requires subjects only to report attitudes, beliefs, and behaviors. It does not involve stress of any form, the manipulation of behavior, or the reporting of illicit behaviors.

I hope to begin the telephone interviewing process by the 20th of October. Please feel free to contact me if you have questions.

Thank you,

_____
John N. Kallas

Dear Dr. Bredeck,

I am Dr. Jenny Bond, John Kallas' major advisor. John's proposed project has been reviewed and approved by his full doctoral committee. If you have any questions please feel free to contact me by phone (5-1756), or by mail (236 Food Science Building, Food Science and Human Nutrition).

Sincerely,

_____
Jenny T. Bond, Ph.D., R.D.
Professor

SOCIAL PERCEPTIONS OF FOOD GROUPING OPTIONS

1. BRIEF ABSTRACT OF RESEARCH:

The USDA's Daily Food Guide, commonly known as the Basic Four, is composed of the following groups; 1) Vegetable-Fruit, 2) Bread-Cereal, 3) Meat-Poultry-Fish-Beans, and 4) Milk-Cheese. The purpose of this research is to investigate if the Daily Food Guide combines conceptually different foods in its food grouping scheme. The hypotheses to be tested are the following summarized into one sentence. Respondents perceive no difference between the constructs 1) 'Fruits' & 'Vegetables, 2) 'Meats' & 'Beans', and 3) 'Plant' & 'Animal Sources of Foods'.

One hundred and sixty Mid-Michigan respondents will be surveyed to completion by telephone. Systematic random digit dialing was used to generate numbers from the Lansing telephone directory. The last two digits were replaced by random numbers to assure randomness, include unlisted numbers, and provide complete anonymity to respondents. Questions concerning attitudes about foods, beliefs about food group attributes, and self reports of food related behaviors will be asked. There are no hidden agendas or experimental manipulations. Hypotheses will be tested using statistical packages available through the MSU computer system. Multiple regression will be used to establish the degree to which food grouping concepts explain each other through common attitudes, attributes, or behaviors. Other exploratory analyses will be conducted on the data as warranted.

2. REQUIREMENTS OF THE SUBJECT POPULATION.

There are no special or unusual requirements of the subject population. Respondents must be voluntary, at least eighteen years of age, and able to be understood by the interviewers.

Subjects will be recruited in the following manner:
Random phone numbers will be dialed. Upon answering the phone the potential respondent will hear this introduction...

> Hello, I'm __(interviewer's name)__ calling from Michigan State University. We are conducting an important scientific study of people's understanding of foods and have some questions we'd like to ask. We assure you that we do not have your name or address and all your responses will remain absolutely confidential. Our survey will take 20 to 30 minutes depending on how quickly we step through it. Would you mind answering some questions for us?

Procedure following response to the introduction:

If the person says OK, then the interview proceeds. If the person is hesitant, the interviewer will be instructed to mention that his/her (the potential respondent's) opinion is of great importance to us, and that the information gathered may eventually be used to improve public education efforts. If the respondent continues avoidance behavior, then he/she is thanked for their time and wished a nice day.

If the person refuses, he/she is thanked and wished9 a nice day.

3. ANALYSIS OF THE RISK-BENEFIT RATIO

There is no known or likely risk of harm to subjects participating in this study. Benefits may be realized by the subjects or society in general through improved public nutrition education efforts. The hope is that the government will be able to more efficiently teach food and nutrition concepts to more people in less time and for less money. These types of savings are passed on to consumers.

4. CONSENT PROCEDURES

Consent is assumed if and when a respondent agrees to the interview following the introduction given above.

5. CONSENT FORMS

Consent is assumed if and when a respondent agrees to the interview following the introductions given above. Since all phone interviews are anonymous and confidential, and only non-controversial questions will be asked, no consent forms were devised.

EXEMPTION FROM FULL COMMITTEE REVIEW

1. Please exempt this proposal from the full review process under your category "C". This research involves survey procedures that maintain the anonymity of respondents. It requires subjects only to report attitudes, beliefs, and behaviors. It does not involve stress of any form, the manipulation of behavior, or the reporting of illicit behaviors.

October 17, 1985 John N. Kallas

MICHIGAN STATE UNIVERSITY

UNIVERSITY COMMITTEE ON RESEARCH INVOLVING
HUMAN SUBJECTS (UCRIHS)
238 ADMINISTRATION BUILDING
(517) 355-2186

EAST LANSING • MICHIGAN • 48824-1046

October 23, 1985

Mr. John N. Kallas
Food Science & Human Nutrition
1, Human Ecology Building

Dear Mr. Kallas:

Subject: Proposal Entitled, "Social Perceptions of Food Grouping Options"

I am pleased to advise that I concur with your evaluation that this project is exempt from full UCRIHS review, and approval is herewith granted for conduct of the project.

You are reminded that UCRIHS approval is valid for one calendar year. If you plan to continue this project beyond one year, please make provisions for obtaining appropriate UCRIHS approval prior to October 23, 1986.

Any changes in procedures involving human subjects must be reviewed by the UCRIHS prior to initiation of the change. UCRIHS must also be notified promptly of any problems (unexpected side effects, complaints, etc.) involving human subjects during the course of the work.

Thank you for bringing this project to my attention. If I can be of any future help, please do not hesitate to let me know.

Sincerely,

Henry E. Bredeck
Chairman, UCRIHS

HEB/jms

cc: Dr. Jenny T. Bond

APPENDIX B

FOOD MODELS

Appendix B contains a list of National Dairy Council Food Models© used for each component of the preliminary research.

FOOD MODELS

Dairy Council Food Models© were used in sorting procedures. Food models included were determined by their availability and representation in at least one of the following three food guides: The Daily Food Guide (USDA), The Guide to Good Eating (National Dairy Council), and the EFNEP Food Planner (EFNEP, USDA). Some foods represented by these guides had no closely matching food model. Representatives of these foods were not found: shrimp, sprouts, uncooked dried beans and peas, uncooked forms of pasta, and tofu. Prepared dried beans and peas did have representative food models and were used. All dried bean and pea models were shown in the rehydrated, cooked state.

One benefit of these food models is that names are printed directly below each picture. This allows the respondent to see a life-size photo of the food, and also to verify their identification of that food by reading its name. Irrelevant information such as serving size or other descriptors beyond the basic name of the food were covered from view. Examples of descriptors deleted in some cases were: ___ leaves, baked ___, chocolate ___,egg- ___, fried ___, hard cooked ___, salted ___, T-bone ___, and vanilla ___.

Sixty four foods were represented in all. They are listed below.

1. Apple
2. Apricots, dried
3. Banana
4. Beans, baked +
5. Beans, green
6. Beans, lima
7. Beans, refried
8. Beets
9. Bread, whole wheat
10. Bread, white
11. Broccoli
12. Cabbage
13. Cantaloupe
14. Carrot sticks
15. Cauliflower
16. Cheese, American
17. Cheese, cheddar
18. Cheese, cottage
19. Cheese, Swiss
20. Chicken (~~fried~~)
21. Corn
22. Cornbread
23. Cornflakes
24. Egg (~~hard-cooked~~)
25. Grapefruit
26. Greens
27. Ham, baked
28. Hominy grits
29. Ice cream (~~vanilla~~)
30. Lettuce leaves
31. Liver, beef
32. Meat patty
33. Milk
34. Milk,butter
35. Noodles (~~egg~~)
36. Oatmeal
37. Okra
38. Onions
39. Orange
40. Orange juice
41. Peaches
42. Peanut Butter
43. Peanuts (~~salted~~)
44. Peas, blackeye
45. Peas, green
46. Perch (~~fried~~)
47. Pineapple
48. Pork chop
49. Potato (~~baked~~)
50. Potato, sweet
51. Pudding (~~chocolate~~)
52. Raisins
53. Rice
54. Roll, frankfurter
55. Roll, hamburger
56. Squash, winter
57. Steak (~~T-bone~~)
58. Strawberries
59. Tomato
60. Tortilla (~~corn~~)
61. Tuna
62. Waffles
63. Watermelon
64. Yogurt

*These food models (3rd ed.) are available from the National Dairy Council, Chicago, Illinois, 60606.

APPENDIX C

OPEN SORT QUESTIONNAIRE

Appendix C contains the preliminary questionnaire used for the open sorting task. Dairy Council Food Models© and a portable table were used along with this questionnaire.

Food Perceptions/Food Models/Open-Sort 1 Page 1

Hi, I'm John Kallas from Michigan State University. We are conducting an important scientific study of people's understanding of foods. Could you spare a few minutes to help with this study? Thank you.

START TIME _____

Here are foods pictured on cardboard. Please sort these foods into piles that make sense to you. You can make as many or as few piles as you feel necessary. Please keep in mind that this is not a test, and there are no right or wrong answers.

<<< THEY SORT FOODS ON TABLE >>>

Questionnaire ID ..... _____ (01-03)
Card 01 (04-05)
Questionnaire # ..... _____ (06-08)
Date ..... _____ (09-11)
Interviewer ..... _____ (12-13)
Location ..... _____ (14)

- Thank you. Now we are going to ask you to do two things,
  first, tell us how you decided which foods went into each pile, and
  second, to name each pile.
  I will point to each pile as we discuss them.

<<< POINT TO THE UPPER LEFT PILE >>>
<<< PROCEED **LEFT-TO-RIGHT** AND **TOP-TO-BOTTOM** WHEN ASKING ABOUT FOOD PILES >>>

1. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
   <<< POINT TO THE PILE >>>
2. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
   <<< POINT TO THE PILE >>>
3. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
   <<< POINT TO THE PILE >>>
4. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
   <<< POINT TO THE PILE >>>
5. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
   <<< POINT TO THE PILE >>>
6. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
   <<< POINT TO THE PILE >>>
7. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
   <<< POINT TO THE PILE >>>
8. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
   <<< POINT TO THE PILE >>>
9. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
   <<< POINT TO THE PILE >>>
10. What would be a good name for the foods of this pile? ..... _____ ( ) ( )
    <<< PUT NAMES OF FURTHER PILES HERE >>>

Finally, We'd like to ask you some questions about yourself.
Your responses are anonymous and confidential.

* NewCard *
Dup (01-03)
Card 02 (04-05)

11. <<< RECORD GENDER HERE >>>

M = (1) F = (2) (06)

12. What percentage of your meals do you prepare yourself?

_____ % (07-09)

13. How many people, besides yourself, do you prepare meals for on a regular basis?

0 1 2 3 4 5 6 7 8 9+ (10)

14. Are you a vegetarian?

Y = (1) N = (2) (11)

15. What is your age?

Age_____ (12-13)

16. What is your marital status?

Never Married (1) _____ (14)
Single (2) _____
Married (3) _____
Divorced (4) _____
Widdow(er) (5) _____

17. What is your occupation?

_____

* Well that's it.
Thank you for your cooperation.

Time

Finish _____ (15-18)

Start _____ (19-22)

Total_____ (23-26).

Food Perceptions/Food Models/Open-Sort — Page 3

Questionnaire # _____

Code Assignment →

			1	2	3	4	5	6	7	8	9	10		Dup (01-03) Card 03	* NewCard * (04-05)*
White	1.	Apple	O	O	O	O	O	O	O	O	O	O	1		(06-07)
	2.	Apricots, dried	O	O	O	O	O	O	O	O	O	O	2		(08-09)
	3.	Banana	O	O	O	O	O	O	O	O	O	O	3		(10-11)
	4.	Beans, baked ✦	O	O	O	O	O	O	O	O	O	O	4		(12-13)
	5.	Beans, green	O	O	O	O	O	O	O	O	O	O	5		(14-15)
	6.	Beans, lima	O	O	O	O	O	O	O	O	O	O	6		(16-17)
	7.	Beans, refried	O	O	O	O	O	O	O	O	O	O	7		(18-19)
	8.	Beets	O	O	O	O	O	O	O	O	O	O	8		(20-21)
	9.	Bread, hole wht	O	O	O	O	O	O	O	O	O	O	9		(22-23)
	10.	Bread, white	O	O	O	O	O	O	O	O	O	O	10		(24-25)
	11.	Broccoli	O	O	O	O	O	O	O	O	O	O	11		(26-27)
	12.	Cabbage	O	O	O	O	O	O	O	O	O	O	12		(28-29)
	13.	Cantaloupe	O	O	O	O	O	O	O	O	O	O	13		(30-31)
			1	2	3	4	5	6	7	8	9	10			
Green	14.	Carrot sticks	O	O	O	O	O	O	O	O	O	O	14		(32-33)
	15.	Cauliflower	O	O	O	O	O	O	O	O	O	O	15		(34-35)
	16.	Cheese, americ	O	O	O	O	O	O	O	O	O	O	16		(36-37)
	17.	Cheese, cheddar	O	O	O	O	O	O	O	O	O	O	17		(38-39)
	18.	Cheese, cottage	O	O	O	O	O	O	O	O	O	O	18		(40-41)
	19.	Cheese, swiss	O	O	O	O	O	O	O	O	O	O	19		(42-43)
	20.	Chicken, **fried**	O	O	O	O	O	O	O	O	O	O	20		(44-45)
	21.	Corn	O	O	O	O	O	O	O	O	O	O	21		(46-47)
	22.	Cornbread	O	O	O	O	O	O	O	O	O	O	22		(48-49)
	23.	Cornflakes	O	O	O	O	O	O	O	O	O	O	23		(50-51)
	24.	Egg, **hard-ckd**	O	O	O	O	O	O	O	O	O	O	24		(52-53)
	25.	Grapefruit	O	O	O	O	O	O	O	O	O	O	25		(54-55)
	26.	Greens	O	O	O	O	O	O	O	O	O	O	26		(56-57)
			1	2	3	4	5	6	7	8	9	10			
Yellow	27.	Ham, baked	O	O	O	O	O	O	O	O	O	O	27		(58-59)
	28.	Hominy grits	O	O	O	O	O	O	O	O	O	O	28		(60-61)
	29.	Ice cream, van	O	O	O	O	O	O	O	O	O	O	29		(62-63)
	30.	Lettuce leaves	O	O	O	O	O	O	O	O	O	O	30		(64-65)
	31.	Liver, **beef**	O	O	O	O	O	O	O	O	O	O	31		(66-67)
	32.	Meat patty	O	O	O	O	O	O	O	O	O	O	32		(68-69)
	33.	Milk	O	O	O	O	O	O	O	O	O	O	33		(70-71)
	34.	Milk,butter	O	O	O	O	O	O	O	O	O	O	34		(72-73)
	35.	Noodles, egg	O	O	O	O	O	O	O	O	O	O	35		(74-75)
	36.	Oatmeal	O	O	O	O	O	O	O	O	O	O	36		(76-77)
	37.	Okra	O	O	O	O	O	O	O	O	O	O	37		(78-79)
			1	2	3	4	5	6	7	8	9	10		Dup (01-03) Card 04	* NewCard * (04-05)*
Blue	38.	Onions	O	O	O	O	O	O	O	O	O	O	38		(06-07)
	39.	Orange	O	O	O	O	O	O	O	O	O	O	39		(08-09)
	40.	Orange juice	O	O	O	O	O	O	O	O	O	O	40		(10-11)
	41.	Peaches	O	O	O	O	O	O	O	O	O	O	41		(12-13)
	42.	Peanut Butter	O	O	O	O	O	O	O	O	O	O	42		(14-15)
	43.	Peanuts, **salted**	O	O	O	O	O	O	O	O	O	O	43		(16-17)
	44.	Peas, blackeye	O	O	O	O	O	O	O	O	O	O	44		(18-19)
	45.	Peas, green	O	O	O	O	O	O	O	O	O	O	45		(20-21)
	46.	Perch, **fried**	O	O	O	O	O	O	O	O	O	O	46		(22-23)
	47.	Pineapple	O	O	O	O	O	O	O	O	O	O	47		(24-25)
	48.	Pork chop	O	O	O	O	O	O	O	O	O	O	48		(26-27)
	49.	Potato, **baked**	O	O	O	O	O	O	O	O	O	O	49		(28-29)
	50.	Potato, **sweet**	O	O	O	O	O	O	O	O	O	O	50		(30-31)
	51.	Pudding, **chocol**	O	O	O	O	O	O	O	O	O	O	51		(32-33)
		1	2	3	4	5	6	7	8	9	10				
Pink	52.	Raisins	O	O	O	O	O	O	O	O	O	O	52		(34-35)
	53.	Rice	O	O	O	O	O	O	O	O	O	O	53		(36-37)
	54.	Roll, frank	O	O	O	O	O	O	O	O	O	O	54		(38-39)
	55.	Roll, hamburger	O	O	O	O	O	O	O	O	O	O	55		(40-41)
	56.	Squash, winter	O	O	O	O	O	O	O	O	O	O	56		(42-43)
	57.	Steak, **T-bone**	O	O	O	O	O	O	O	O	O	O	57		(44-45)
	58.	Strawberries	O	O	O	O	O	O	O	O	O	O	58		(46-47)
	59.	Tomato	O	O	O	O	O	O	O	O	O	O	59		(48-49)
	60.	Tortilla, corn	O	O	O	O	O	O	O	O	O	O	60		(50-51)
	61.	Tuna	O	O	O	O	O	O	O	O	O	O	61		(52-53)
	62.	Waffles	O	O	O	O	O	O	O	O	O	O	62		(54-55)
	63.	Watermelon	O	O	O	O	O	O	O	O	O	O	63		(56-57)
	64.	Yogurt	O	O	O	O	O	O	O	O	O	O	64		(58-59)

APPENDIX D

STRUCTURED SORT QUESTIONNAIRE

Appendix D contains one of three preliminary questionnaires that were used for structured sorting tasks. Dairy Council Food Models© and a sandwich-board stand (Figure 6) were used along with this questionnaire. These three questionnaires differed by the food grouping constructs used. The three sets of food grouping constructs used are listed below. The questionnaire begins on the next page.

Food Grouping Constructs Used for Preliminary Sorting Tasks and Magnitude Scaling

EFNEP Food Planner	Daily Food Guide	Briefest Terms
Meat, Poultry, Fish, Eggs	Meat, Poultry, Fish, Beans	Meats
Dried Beans & Peas		Legumes
Fruits	Vegetable, Fruits	Fruits
Vegetables		Vegetables
Bread, Cereal, Pasta	Bread, Cereal	Grains
Milk, Cheese	Milk, Cheese	Dairy

Food Perceptions/Food Models/DFG-1 Page 1

Hi, I'm John Kallas from Michigan State University. We are conducting an important scientific study of people's understanding of foods. Could you spare a few minutes to help with this study? Thank you.

First, are you a practicing nutrition professional? <<< IF NO ___ CONTINUE >>> START TIME _____

Here are pockets labeled ... Bread, Cereal / Vegetable, Fruits
Milk, Cheese / Meat, Poultry, Fish, Beans
? = All other foods

Please place the foods pictured here in the pockets you associate them with. Foods unrelated to labeled pockets should be put into the " ? " pocket. Please keep in mind that this is not a test, and there are no right or wrong answers.

<<< THEY PUT FOODS IN ENVELOPES >>>

Questionnaire ID..... _____ (01-03)
Card 01 (04-05)
Questionnaire #..... _____ (06-08)
Date..... _____ (09-11)
Interviewer ..... _____ (12-13)
Location..... _____ (14)

Thank you.

1. Some of the pockets before you have more than one type of food listed on them. In your opinion, are any of these foods different enough to belong in a separate envelope? IF YES ___ How are they different? (15-20)

<<< PLACE " ? " FOODS IN FRONT OF RESPONDENT >>>

2. Why are these other foods separated out?---------- None:_____ (21-26)

3. How are they different from the others?---------- (27-32)

4. Now we are going to use numbers to rate "how different" certain foods are.
The numbers go from 0 to 100 .
Zero means the foods are identical to you. One hundred means the foods are totally different to you.
You can use any number from 0 to 100 to show how different you feel the foods are.
Now, how different are ...

Beans	and ..... Meats, Poultry, Fish	_____1	(33-35)
Fruits	and ..... Vegetables	_____2	(36-38)
Meats, Poultry, Fish	and ..... Milk, Cheese	_____3	(39-41)
Vegetables	and ..... Beans	_____4	(42-44)

5. In your opinion, how are Beans — and — Meats, Poultry, Fish different?
((POINT TO THEM)) 5 (45-50)

6. How are they Similar?---------- 6 (51-56)

7. In your opinion, how are Vegetables — and — Beans different? ----------
((POINT TO THEM)) 7 (57-62)

8. How are they similar? ----------
8 (63-68)

9. In your opinion, how are Fruits — and — Vegetables different? ----------
((POINT TO THEM)) 9 (69-74)

10. How are they similar? ----------
10 (75-80)

* Finally, We'd like to ask you some questions about yourself. Your responses are anonymous and confidential.

* NewCard *
Dup (01-03)
Card 02 (04-05)

11. <<< RECORD GENDER HERE >>>
M = (1) F = (2) (06)

12. What percentage of your meals do you prepare yourself?
_____ % (07-09)

13. How many people, besides yourself, do you prepare meals for on a regular basis?
0 1 2 3 4 5 6 7 8 9+ (10)

14. Are you a vegetarian?
Y = (1) N = (2) (11)

15. What is your age?
Age_____ (12-13)

16. What is your marital status?
Never Married (1) _____ (14)
Single (2) _____
Married (3) _____
Divorced (4) _____
Widdow(er) (5) _____

17. What is your occupation? _____

Well that's it.
Thank you for your cooperation.

Time..... Finish _____ (15-18)

Start _____ (19-22)

Total_____ (23-26).

Questionnaire # _____

Daily Food Guide			VgFr	BrCe	Meat	Milk	?	* NewCard *Dup * Card 03	(01-03) (04-05)
White	1.	Apple	8	9	10	11	7	1	(06-07)
	2.	Apricots, dried	8	9	10	11	7	2	(08-09)
	3.	Banana	8	9	10	11	7	3	(10-11)
	4.	Beans, baked +	8	9	10	11	7	4	(12-13)
	5.	Beans, green	8	9	10	11	7	5	(14-15)
	6.	Beans, lima	8	9	10	11	7	6	(16-17)
	7.	Beans, refried	8	9	10	11	7	7	(18-19)
	8.	Beets	8	9	10	11	7	8	(20-21)
	9.	Bread, hole wht	8	9	10	11	7	9	(22-23)
	10.	Bread, white	8	9	10	11	7	10	(24-25)
	11.	Broccoli	8	9	10	11	7	11	(26-27)
	12.	Cabbage	8	9	10	11	7	12	(28-29)
	13.	Cantaloupe	8	9	10	11	7	13	(30-31)
			VgFr	BrCe	Meat	Milk	?		
Green	14.	Carrot sticks	8	9	10	11	7	14	(32-33)
	15.	Cauliflower	8	9	10	11	7	15	(34-35)
	16.	Cheese, americ	8	9	10	11	7	16	(36-37)
	17.	Cheese, cheddar	8	9	10	11	7	17	(38-39)
	18.	Cheese, cottage	8	9	10	11	7	18	(40-41)
	19.	Cheese, swiss	8	9	10	11	7	19	(42-43)
	20.	Chicken, **fried**	8	9	10	11	7	20	(44-45)
	21.	Corn	8	9	10	11	7	21	(46-47)
	22.	Cornbread	8	9	10	11	7	22	(48-49)
	23.	Cornflakes	8	9	10	11	7	23	(50-51)
	24.	Egg, **hard-ckd**	8	9	10	11	7	24	(52-53)
	25.	Grapefruit	8	9	10	11	7	25	(54-55)
	26.	Greens	8	9	10	11	7	26	(56-57)
			VgFr	BrCe	Meat	Milk	?		
Yellow	27.	Ham, baked	8	9	10	11	7	27	(58-59)
	28.	Hominy grits	8	9	10	11	7	28	(60-61)
	29.	Ice cream, van	8	9	10	11	7	29	(62-63)
	30.	Lettuce leaves	8	9	10	11	7	30	(64-65)
	31.	Liver, beef	8	9	10	11	7	31	(66-67)
	32.	Meat patty	8	9	10	11	7	32	(68-69)
	33.	Milk	8	9	10	11	7	33	(70-71)
	34.	Milk,butter	8	9	10	11	7	34	(72-73)
	35.	Noodles, egg	8	9	10	11	7	35	(74-75)
	36.	Oatmeal	8	9	10	11	7	36	(76-77)
	37.	Okra	8	9	10	11	7	37	(78-79)
								* NewCard *Dup	(01-03)
			VgFr	BrCe	Meat	Milk	?	* Card 04	(04-05)
Blue	38.	Onions	8	9	10	11	7	38	(06-07)
	39.	Orange	8	9	10	11	7	39	(08-09)
	40.	Orange juice	8	9	10	11	7	40	(10-11)
	41.	Peaches	8	9	10	11	7	41	(12-13)
	42.	Peanut Butter	8	9	10	11	7	42	(14-15)
	43.	Peanuts, **salted**	8	9	10	11	7	43	(16-17)
	44.	Peas, blackeye	8	9	10	11	7	44	(18-19)
	45.	Peas, green	8	9	10	11	7	45	(20-21)
	46.	Perch, **fried**	8	9	10	11	7	46	(22-23)
	47.	Pineapple	8	9	10	11	7	47	(24-25)
	48.	Pork chop	8	9	10	11	7	48	(26-27)
	49.	Potato, **baked**	8	9	10	11	7	49	(28-29)
	50.	Potato, **sweet**	8	9	10	11	7	50	(30-31)
	51.	Pudding, **choccl**	8	9	10	11	7	51	(32-33)
			VgFr	BrCe	Meat	Milk	?		
Pink	52.	Raisins	8	9	10	11	7	52	(34-35)
	53.	Rice	8	9	10	11	7	53	(36-37)
	54.	Roll, frank	8	9	10	11	7	54	(38-39)
	55.	Roll, hamburger	8	9	10	11	7	55	(40-41)
	56.	Squash, winter	8	9	10	11	7	56	(42-43)
	57.	Steak, **T-bone**	8	9	10	11	7	57	(44-45)
	58.	Strawberries	8	9	10	11	7	58	(46-47)
	59.	Tomato	8	9	10	11	7	59	(48-49)
	60.	Tortilla, corn	8	9	10	11	7	60	(50-51)
	61.	Tuna	8	9	10	11	7	61	(52-53)
	62.	Waffles	8	9	10	11	7	62	(54-55)
	63.	Watermelon	8	9	10	11	7	63	(56-57)
	64.	Yogurt	8	9	10	11	7	64	(58-59)

APPENDIX E

TELEPHONE SURVEY QUESTIONNAIRE

Appendix E contains interviewer instructions and final telephone survey materials. This survey was conducted with a random sample of 162 Mid-Michigan consumers. Appendix E contents are...

- Interviewer Guidelines
- Telephone Survey Questionnaire Used to Test the Hypotheses

  Individual questionnaires differed by order of question presentation. Percent estimate and direct magnitude scaling questions were rotated randomly. This was done to reduce order bias. Otherwise all questionnaires were identical to the one that follows.

INTERVIEWER GUIDELINES

Attitude: Be polite, friendly, and empathic.
Respect their time and situation while recognizing the importance of this study.

Tone: Speak clearly in a conversational voice, not too loud or soft.
Show interest in their responding without guiding them to specific responses.

Start questioning:
Immediately begin questioning at any point the respondent agrees to participate.

Hesitant respondents: Assure them that their opinion is important and that it may help to improve public education around the country.
If timing is bad, ask for a better time to call (Get a specific time). Thank them!
If still resistant, thank them politely wish them a nice day.

Age: The sample is 18 years of age or older.
If a child answers the phone, ask for an adult.
If no adult is present, try to find out when to call back and mark the code sheet (CB).

Don't chit-chat!:
Following a response go immediately to the next question.
Be firm yet polite and friendly about moving on.
Their elaboration of answers is unnecessary and time consuming.
Remind them that you have other questions to complete and you don't want to waste their time.

Hang-ups, Refusals, Terminations:
Some people will hang up on you as soon as they realize you are conducting a survey.
Some won't want to participate and will tell you so.
Others will answer some of the questions and will hang up or refuse to finish the rest of the questions. Don't forget to remind them, if you have a chance, that...
a) Their opinion is very important to us.
b) Their questionnaire will be useless if it is only partially completed.
c) You can re-schedule to finish at a more convenient time.
If they continue to refuse, thank them before terminating the call

Don't take rejection personally.
Be pleasant and friendly at all times

Listing of food groups
Make sure that when foods from the same column are said together that you verify...
Is it Fruits and Vegetables as one group or Fruits and Vegetables as two groups.

Rough spots
The second matrix on page 3 and the paired comparisons on page 4.
Be patient. Be reasonably enthusiastic.
Don't let guilt (of asking so many repetitive questions) make you uncomfortable.
If you move quickly, most respondents will mind less than you.

Review all questions as soon as you hang-up.
Make responses legible.
Complete abbreviated responses
Spell words out.

Time-line
Due to the potentially confounding effects of Thanksgiving on food perceptions, it is important to complete interviewing by November 20. Please schedule your interviewing within this time factor.

GENERAL TIPS

Get exact counts
If someone says 4 or 5 meals, ask them: Which is the more accurate number, 4 or 5?

Never offer guess numbers
It is tempting, but do not do it. Only repeat reference information.

If you do not understand an answer:
Ask them to repeat their answer.
Do not paraphrase

Questioning Technique
Be warm, friendly, and pleasant at all times.
Cold mechanical interviewers will get more resistance (headache producing) and terminations.
Your tone should be conversational.
Do not say "OK" or anything between questions. This wastes time and sounds redundant to the respondent.
Just move quickly. Begin the next question instantly as they finish the last.
The more time you take, the longer the interview. This is bad for both you and the respondent.
The quicker you move on, the less time they have to get bored or think about time.
Do not say "Uh-Huh!", say, "Yes".

RESPONDENT MANAGEMENT & BOOKKEEPING

Think: Re-schedule Reschedule Reschedule
Try to do it now, but be more than happy to reschedule.
If its a bad time to call: Reschedule
If they have to go: Reschedule

Re-scheduling Procedure:
Politely narrow people down to as specific a time as you can.
If they say afternoon, ask them what is the best time in the afternoon.

Call Backs
These are very serious matters.
It is your responsibility to follow-up on call-backs.
You must call back when you say you will call back.
As you hang up check your calendar. If there is a conflict, contact John immediately.

Phone Sheet Procedure
Note: Do not re-dial a "NA" number within 2 hours of the last call.

CALLER CODING

Bookkeeping information:

Record all needed information at the top of the questionnaire

- Calculate the day of the year
- Locations are coded as the following:
  - 1 = Room 1 HE
  - 1 = 405 HE
  - 2 = Your home
  - 3 = Other

Open ended questions:

Record respondent answers in the order that they are given. Write down as much as you can unless a limit is specified.

Person doesn't respond well to question:

If the respondent has no answer, go to the next question.
If the respondent doesn't understand the question, reread it.
Do not prompt the respondent unless you are instructed to do so.

When to leave a blank space:

If the respondent does not answer a question.
If the respondent refuses to answer a question.
It is not good to have blanks in the matrix questions, but whatever you get will be used.

•Parts of this document were adapted from...
Caller Instructions prepared by Kimberly Ann Downing, MIRA Corp., February, 1984.

Food Perceptions/FQ~Final Page 1

Questionnaire ID	_____	(01-03)
Card 01	__01__	(04-05)
Respondent #	_____	(06-08)
Day of year (Mon's: Nov 11=315, 18=322, 25=329, 2=336)	_____	(09-11)
Year	__85__	(09-10)
Caller's ID	_____	(12-15)
Location of call	_____	(16)
Start time (24 hr clock) AM = 1-12 PM = 12 + (1-12)	_____	(17-20)

Hi, I'm _____ from Michigan State University. We're conducting an important scientific study of people's understanding of foods. We have some questions we'd like to ask and assure you that all your responses are anonymous.
Would you help us with this study? Thank you.
(IF ? ANONYMITY: All numbers were randomly generated. We do not know or have access to your name or address.)
(IF ? TIME: This survey will take 15 to 25 minutes depending on how quickly we step through it.)
... Shall we go on? (AT LEAST 18 YRS OLD IF BUSY, RESCHEDULE)

First, we'd like to ask you some questions about meals ...

1. On the average, how many meals do you make yourself, per week? _____ ()

<If "0" skip to question 9>

2. What does the phrase "Making a meal from scratch" mean to you? <NOT: Boxed Canned Frozen TV Dinner>
_____ ()
3. How many sit-down meals do you make from scratch, per week? _____ ()
4. What comes to mind when I say "Pre-packaged dinner"? <IS: Boxed Canned Frozen TV Dinner>
_____ ()
5. How many sit-down meals do you make from pre-packaged or frozen dinners, per week? _____ ()
6. How many meals do you plan, more than one day ahead of time, per week? _____ ()
7. Besides yourself, for how many people, do you make at least one meal a day? _____ ()
8. Do you use a microwave oven? Y_1_ N_0_ ()
9. What comes to mind when I say "A meal"? _____
_____ ()
10. In your opinion, what are "Dried beans and peas"? _____
_____ ()
11. How many sit-down meals do you have with other members of your household, per week? _____ ()
12. How many times do you go food shopping, per month? _____ ()
13. Have you been on a weight reduction diet in the last year? Y_1_ N_0_ ()
<If Yes ...> 13a. Are you on a weight reduction diet now? Y_1_ N_0_ ()
14. In your opinion, what is the purpose of "a Food Guide"? _____
_____ ()
15. In your opinion, what is it that makes a food, "Nutritious"? _____
_____ ()

Food Perceptions/FQ~Final Page 2

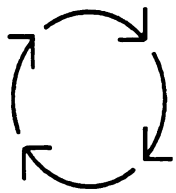
<Try to record at least 4. If abundant, record 1st "Set" of responses>

What foods come to mind when I say... <If less than 4... Can you name some other _____'s>

VEGETABLES THAT
16. HAVE PROTEIN _____ ( )
1. Baby peas _____ ( )
2. Baked beans _____ ( )
3. Beans _____ ( )
4. Blackeyed peas _____ ( )
5. Broccoli _____ ( )
6. Cauliflower _____ ( )
7. Corn _____ ( )
8. French beans _____ ( )
9. Green beans _____ ( )
10. Kidney beans _____ ( )
11. Legumes _____ ( )
12. Lentils _____ ( )
13. Lima beans _____ ( )
14. Navy beans _____ ( )
15. Northern beans _____ ( )
16. Peanuts _____ ( )
17. Peanut butter _____ ( )
18. Peas _____ ( )
19. Pinto beans _____ ( )
20. Pole beans _____ ( )
21. Potatoes _____ ( )
22. Red beans _____ ( )
23. Snow peas _____ ( )
24. Soy beans _____ ( )
25. Spinach _____ ( )
26. Split peas _____ ( )
27. String beans _____ ( )
28. Sweet peas _____ ( )
29. Tofu _____ ( )
30. Wax Beans _____ ( )
31. Yellow Beans _____ ( )
32. Others _____ ( )
33. NONE _____ ( )

FOODS FROM
17. ANIMALS _____ ( )
1. Bacon _____ ( )
2. Beef _____ ( )
3. Butter _____ ( )
4. Cheese _____ ( )
5. Chicken _____ ( )
6. Dairy (Products) _____ ( )
7. Eggs _____ ( )
8. Fish _____ ( )
9. Ground beef _____ ( )
10. Ham _____ ( )
11. Hamburger _____ ( )
12. Lamb _____ ( )
13. Meat _____ ( )
14. Milk (Products) _____ ( )
15. Pork _____ ( )
16. Poultry _____ ( )
17. Protein _____ ( )
18. Roast _____ ( )
19. Roast beef _____ ( )
20. Roast pork _____ ( )
21. Steak _____ ( )
22. Turkey _____ ( )
23. Veal _____ ( )
24. Venison _____ ( )
25. Yogurt _____ ( )
26. Others _____ ( )
27. NONE _____ ( )

18. FRUITS _____ ( )
1. Apples _____ ( )
2. Bananas _____ ( )
3. Berries _____ ( )
4. Blueberries _____ ( )
5. Cantaloup _____ ( )
6. Cherries _____ ( )
7. Grapes _____ ( )
8. Grapefruit _____ ( )
9. Melons _____ ( )
10. Oranges _____ ( )
11. Peaches _____ ( )
12. Pears _____ ( )
13. Pineapples _____ ( )
14. Plum _____ ( )
15. Prunes _____ ( )
16. Strawberries _____ ( )
17. Tomatoes _____ ( )
18. WaterMelon _____ ( )
19. Others _____ ( )
20. NONE _____ ( )



19. BEANS: _____ ( )
1. Baked beans _____ ( )
2. Beans _____ ( )
3. Chili beans _____ ( )
4. Dried beans _____ ( )
5. French beans _____ ( )
6. Green beans _____ ( )
7. Kidney beans _____ ( )
8. Legumes _____ ( )
9. Lentil beans _____ ( )
10. Lima beans _____ ( )
11. Navy beans _____ ( )
12. Northern beans _____ ( )
13. Pinto beans _____ ( )
14. Pole beans _____ ( )
15. Pork and beans _____ ( )
16. Red beans _____ ( )
17. Soy beans _____ ( )
18. String beans _____ ( )
19. Wax beans _____ ( )
20. Yellow beans _____ ( )
21. Others _____ ( )
22. NONE _____ ( )

FOODS FROM
22. PLANTS _____ ( )
1. Apples _____ ( )
2. Asparagus _____ ( )
3. Beans _____ ( )
4. Beets _____ ( )
5. Broccoli _____ ( )
6. Brussels Sprouts _____ ( )
7. Cabbage _____ ( )
8. Carrots _____ ( )
9. Cauliflower _____ ( )
10. Celery _____ ( )
11. Cereal _____ ( )
12. Corn _____ ( )
13. Cucumber _____ ( )
14. Fruits _____ ( )
15. Fruits-Vegetables _____ ( )
16. Greens _____ ( )
17. Green Vegetables _____ ( )
18. Kale _____ ( )
19. Lettuce _____ ( )
20. Peas _____ ( )
21. Potatoes _____ ( )
22. Protein _____ ( )
23. Rhubarb _____ ( )
24. Salad Foods _____ ( )
25. Spinach _____ ( )
26. Squash _____ ( )
27. Strawberries _____ ( )
28. Tomato _____ ( )
29. Turnips _____ ( )
30. Vegetables _____ ( )
31. Zucchini _____ ( )
32. Others _____ ( )
33. NONE _____ ( )

MEAT,
21. POULTRY, FISH _____ ( )
1. Bacon _____ ( )
2. Beef _____ ( )
3. Chicken _____ ( )
4. Cod _____ ( )
5. Eggs _____ ( )
6. Fish _____ ( )
7. Ground beef _____ ( )
8. Ham _____ ( )
9. Hamburger _____ ( )
10. Lamb _____ ( )
11. Lobster _____ ( )
12. Meat _____ ( )
13. Meat Loaf _____ ( )
14. Mutton _____ ( )
15. Orange roughy _____ ( )
16. Pork _____ ( )
17. Poultry _____ ( )
18. Protein _____ ( )
19. Roast _____ ( )
20. Roast beef _____ ( )
21. Salmon _____ ( )
22. Seafood _____ ( )
23. Shrimp _____ ( )
24. Steak _____ ( )
25. Trout _____ ( )
26. Tuna _____ ( )
27. Turkey _____ ( )
28. Veal _____ ( )
29. Venison _____ ( )
30. Others _____ ( )
31. NONE _____ ( )

20. VEGETABLES _____ ( )
1. Asparagus _____ ( )
2. Beans _____ ( )
3. Beets _____ ( )
4. Broccoli _____ ( )
5. Cabbage _____ ( )
6. Carrots _____ ( )
7. Cauliflower _____ ( )
8. Celery _____ ( )
9. Corn _____ ( )
10. Cucumber _____ ( )
11. Dried beans _____ ( )
12. Greens _____ ( )
13. Green beans _____ ( )
14. Green peas _____ ( )
15. Kale _____ ( )
16. Lettuce _____ ( )
17. Onions _____ ( )
18. Peas _____ ( )
19. Potatoes _____ ( )
20. Rhubarb _____ ( )
21. Salad Foods _____ ( )
22. Spinach _____ ( )
23. Squash _____ ( )
24. String Beans _____ ( )
25. Sweet Potatoes _____ ( )
26. Tomato _____ ( )
27. Turnips _____ ( )
28. Zucchini _____ ( )
29. Others _____ ( )
30. NONE _____ ( )

23. In your opinion, what is the difference between a side dish and a main dish? _____

_____ ()

In the next section we will ask, what percent of the time your main dishes, side dishes, breakfasts, desserts, and snacks have certain kinds of foods in them.

What percent of the time do your...

	Vegetables	Beans	Fruits	Meat, Poultry, Fish	Foods From Animals	Foods From Plants
24. Main Dishes include...						
25. Side Dishes include...						
26. Breakfasts include...						
27. Desserts include...						
28. Snacks include...						

In the next set of questions, please remember there are no right or wrong answers, just your own personal opinions.

Here we would like you to use numbers to rate if you think foods are above or below average in certain characteristics. On this scale, ten means average. To rate a food as being below average, say a number below ten. To rate a food as above average, say a number above ten. Zero means a food has absolutely none of the characteristic, and you can go as far up the scale as you want.

So, if ten means an average amount of...

	Vegetables	Beans	Fruits	Meat, Poultry, Fish	Foods From Animals	Foods From Plants
29. Work, how much Work to Prepare are						
30. Like, . how much do you Like to Eat						
31. Protein, how much Protein is there in						
32. Fat, ... how much Fat is there in						
33. Vitamins, . . how Vitamin Filled are						
34. Sweet, ... how Sweet are						
35. Nutrition, ... how Nutritious are						
36. Fullness, ... how Filling are						
37. Good, ... how Good For You are						
38. Juiciness, ... how Juicy are						

Now we are going to ask you some questions about yourself.
Please remember that your responses are anonymous and confidential.

39. < RECORD GENDER >..... Male = 1 Female = 2 ()

40. What is your age?..... Age _____ ()

41. What is your race or ethnic background?..... _____ ()

42. What is your occupation?..... _____ ()

43. Counting yourself, how many people live in your household?.....1 2 3 4 5 6 7 8 9+ ()

44. How many children under 18 years of age live at home with you?.....0 1 2 3 4 5 6 7 8 9+ ()

45. What is your height? < CODE IN INCHES >.....(____ft ____in) = _____ ()

46. What is your weight in pounds?..... _____ ()

47. What is your marital status? Single = 1 Separated = 3 Widow(er) = 5
Married = 2 Divorced = 4 Refused = 9 ()

48. Is your total annual household income more than $ 10,000? No = 0..... Yes = 1
more than $ 15,000?.....2
more than $ 25,000?.....3
more than $ 40,000?.....4
more than $ 60,000?.....5
Don't Know.....9
Refuse to answer.....[ ] ()

Now we will use numbers to judge how <u>different</u> or "far apart" two foods are from each other. If you think there is <u>no difference</u> between foods, that is, you think that they are the same or identical to each other, say <u>zero</u>, which means <u>no difference</u>. The greater the difference, the further you go up the scale. Let's say that the difference between Vegetables and Fruits is ten. For differences larger than that, use numbers larger than ten; less different, use numbers less than ten. The larger the difference, the larger the number.

Now, if the difference between Vegetables and Fruits is ten, how different are...

		Beans	Vegetables	Fruits	Meat, Poultry, Fish	Foods From Animals
49.	Vegetables	[ ][ ]	:			
50.	Fruits	[ ][ ]	[ ][ ]			
51.	Meat, Poultry, Fish	[ ][ ]	[ ][ ]	[ ][ ]		
52.	Foods From Animals	[ ][ ]	[ ][ ]	[ ][ ]	[ ][ ]	
53.	Foods From Plants	[ ][ ]	[ ][ ]	[ ][ ]	[ ][ ]	[ ][ ]

↑ ← AND

<u>And finally, here are some questions about nutrition information...</u>

54. From <u>where</u> have <u>you</u> learned the most about nutrition in your life?
<Home? School? Magazines? TV? People? Books? > _____ ()

55. <u>Who</u> do <u>you</u> turn to if you want specific information about nutrition?
<Mom? Teachers? Doctor? Grocer? > _____ ()

<If no one> 55a. If you had to find out some <u>important</u> information about nutrition, where would you get that information?

_____ ()

56. If new information came out, about nutrition, how would you most likely find out about it?

_____ ()

57. What level of education have you completed? Grade School = 1, High School = 2, Some College = 3, College Degree = 4, Some Graduate = 5, Grad Degree = 6, Prof Degree = 7 ()

Do you remember having nutrition as a topic in...

	No	Yes	Can't Remember Don't Know	
58. Grade School?	0	1	9	()
59. High School?	0	1	9	()
60. College?	0	1	9	()
61. Graduate School?	0	1	9	()
62. A Government Program?	0	1	9	()
63. Any Other Place _____		No [ ]		()
64. Have you heard of the "Basic Four" food groups?	0	1	9	()
<If Yes> 65. Was it ever taught to you in school?	0	1	9	()
66. Do you use the "Basic Four" now to help guide your food choices?	0	1	9	()
<If Yes> 67. Please describe exactly how you use it? <Do you use general principles or follow it to the letter?, Please explain> _____				()
68. Can you recall the "Basic Four" food groups?	0	1	9	()
<If yes> 69. Can you tell us what those groups are?... Refused ()>				

Meats...

Eggs ___()
Fish ___()
Meat(s) ___()
Meats-**Beans** ___()
Meat-Fish ___()
Meat-Poultry ___()
Meat-Poultry-Fish ___()
Meat-Poultry-Fish-**Beans** ___()
Meat-Poultry-Fish-Eggs ___()
Poultry ___()
Poultry-Fish ___()
Protein ___()

Grains ...

Bread ___()
Bread-Cereal ___()
Bread-Cereal-Pasta ___()
Cereal ___()
Cereal-Grains ___()
Grains ___()
Pasta ___()
Rice ___()
Starches ___()

Fat(s) ___()
Sweets ___()
Fat-Sweets ___()
Fat-Sweets-Alcohol ___()

Beans/Fruits/Vegetables..

Beans ___()
Dried Beans-Peas ___()
Fruits ___()
Fruits-Vegetables ___()
Green Vegetables ___()
Vegetables ___()

Dairy ...

Dairy (Products) ___()
Cheese ___()
Milk (Products) ___()
Milk-Cheese ___()

Other _____ ()

70. What stops you from using food guides, more than you do now? _____

_____ ()

* Well that's it!
Thank you for your cooperation.

Time interview ended (24 Hour Clock) ___:___ ()

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