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ABSTRACT

A study examined children's conceptions about nutrients and the dimensions underlying their classifications of foods into groups. Children (5 to 11 years old) classified 71 foods into groups by whatever criteria they wished. These classifications were recorded, as were the children's answers to questions about nutrients and their responses in tasks assessing cognitive developmental level. Analysis of classification data yielded four major food groups. One difference from the "Basic Four" food groups involved the presence of a sweets group. Analysis revealed common underlying dimensions of sweet vs. non-sweet foods and meal entrees vs. drinks and breakfast foods, suggesting that perceptual, functional, and physical properties of foods influenced food classifications. Only "concrete operational" children were influenced by dimensions involving degree of food processing and food origin. Understanding of nutrients improved with cognitive developmental level, but generally poor understanding was evident. Results highlight the need to design health education curricula that are appropriate to students' cognitive developmental levels. (Authors/CJ)

Spontaneous Classification of Foods by Children at Varying Cognitive Developmental Levels

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Abstract

Despite the widespread use in nutrition education of a nutritional guide describing the Basic Four Food Groups, previous studies suggest that children lack the concepts assumed in use of the guide. This study examined children's conceptions about nutrients and the dimensions underlying their classifications of foods into groups. Children aged 5 to 11 (59 girls and 56 boys) placed 71 foods into groups by whatever criteria they wished. The bases of these classifications were recorded, as were the children's answers to questions about nutrients and their responses in tasks assessing cognitive developmental level. A cluster analysis of the classification data yielded four major groups of foods, but differences from the Basic Four included presence of a sweets group. Multidimensional scaling analysis revealed common underlying dimensions of sweet vs. non-sweet foods and meal entrees vs. drinks and breakfast foods, suggesting that perceptual, functional, and physical properties of foods influenced food classifications by children regardless of cognitive developmental level. However, only "concrete operational" children were influenced by dimensions involving degree of processing of foods and origin of foods in plants or animals. Understanding of nutrients improved with cognitive developmental level, but generally poor understanding was evident. The results highlight the need to design health education curricula that are appropriate to students' cognitive developmental levels and to their naturally occurring conceptualizations. Psychologists may contribute to this effort by detailing cognitive and motivational determinants of eating behavior, in relation to models of communication effectiveness and self-regulation of behavior.

Spontaneous Classification of Foods by Children at Varying Cognitive Developmental Levels

Nutrition educators have frequently noted that nutrition education should be conducted in a manner to be understood and effectively acted upon to bring about desirable eating practices (National Conference on Nutrition Education, 1980; White House Conference on Food, Nutrition and Health, 1970). Accordingly, nutritionists have through the decades designed for public education various food guides which "convert the professional's scientific knowledge of food composition and nutrient requirements for health into a practical plan for selection by those without training in nutrition" (Pennington, 1977, p. 53). The Basic Four or the Four Food Groups, which is the guide currently used with all age groups, is especially popular with children inasmuch as it provides relatively specific instructions assumed to be understandable to children. Thus in a review of nutrition education research studies and curricula used in the past decade, Contento (1981) found that the majority were based on teaching about the Four Food Groups. Yet, as Light and Cronin (1981) note, "there is no record in the nutrition literature of scientifically designed studies to test the usability aspects of any food guide," and "technically accurate food guides fail if they cannot be understood, remembered, and effectively used by their intended audiences" (p. 59).

There is some evidence that suggests that children may have difficulty understanding a classification system that places foods into groups largely on the basis of their nutrient composition as is the case with the Basic Four system. For example, in this system meat, beans and nuts are placed

into the same groups based on their high protein content, and orange juice and potato chips are placed into the same group because they are derived from fruits and vegetables which are grouped together because of their high concentrations of essential vitamins and minerals. In addition, several studies suggest that children do not relate nutrients to food and its effect on the body. In one study with children 5 to 11 years of age (Contento, 1981), the youngest viewed foods as unchanged in the body. Slightly older children viewed foods as undergoing some changes in physical form (e.g. to small particles) but only a few of the oldest children demonstrated an understanding that food brought about its effects on the body through components of food -- called nutrients. In a similar vein, the younger children had difficulty understanding that such terms as "sugar" and "vitamins" -- terms they were familiar with -- were components of "food." Nagy (1953) and Gellert (1962) found very similar beliefs about the fate and effect of food in the body among children of the same age group. All three researchers interpreted their results in Piagetian terms as resulting from the limitations in understanding imposed by children's cognitive developmental level.

Because children may have difficulty understanding a nutrient-based food classification system, research is needed on the bases children do indeed use to classify foods. This information could be used to develop teaching strategies and food guides that are more effective for children. Accordingly, the present study was designed to investigate (a) the groups into which foods are spontaneously classified by children aged 5 to 11, (b) the dimensions underlying classification judgments and (c) children's understanding of nutrients. Because considerable changes in cognitive

development occur during this age range, the study also investigates whether children's understandings and classification systems change with developmental level.

Method

Sample

Participants were children from two urban and three suburban public schools in two metropolitan centers in the American northeast. There were 115 participants in all -- 59 females and 56 males; 16 blacks, 20 Spanish-speaking, and 79 whites. They were mostly middle-class with a few of them from lower socioeconomic classes. They ranged in age from 5 to 11-1/2 years.

Assessment of Cognitive Developmental Level

The participants were classified into pre-operational and concrete operational stages on the basis of two standard Piagetian tasks: a conservation of substance task involving clay balls (Lovell and Ogilvie, 1960) and a classification task in which the child is presented with pictures of ducks, birds, animals, and non-animals and is asked to place them in groups labeled "ducks," "birds," and "animals" (Inhelder and Piaget, 1964). Children were classified as pre-operational if they could not understand that a clay ball had the same amount of substance when its shape was changed and if they classified on the basis of irrelevant variables and could not understand the notion of inclusion of classes (Piaget's "stage I" classification). Children were classified as concrete operational if they understood the notion of conservation of substance and if they demonstrated an understanding of the notion of a hierarchy of classification and the quantification of inclusion (there are other animals besides birds, for

example). Children were designated early concrete reasoners if they were only partially successful at the classification task (Piaget's "stage II") and were designated late concrete reasoners (Piaget's "stage III") if they were immediately successful and complete at the task. From these tasks 28 children (ages 5 through 8) demonstrated pre-operational thinking, 38 (ages 6 through 10) demonstrated early concrete operational thinking and 42 (ages 7 through 11-1/2) demonstrated a mature classification behavior or fully concrete operational thought. Because tasks for assessing formal operational thought were not used, however, some of the children demonstrating mature classification abilities may have been formal reasoners. Cognitive development level was not assessed for 7 children, so their responses were omitted whenever data were analyzed specifically by cognitive level.

Interviews

The interviews on children's food classification systems were conducted individually, usually in some unused room in the given school. The child was presented with pictures of 71 foods, 11 of which were mixed foods such as sandwiches or spaghetti and meat sauce, and the remainder were single food items. The child was then instructed to classify the foods by groups that were alike in some way or should be in the same group. The child was told that this task was not a test, that there were no right or wrong answers, and that we would not discuss with the teacher or parents what he or she did in this session. We emphasized that "we are interested in which foods you think should be put in the same groups and why." The foods placed together into groups were recorded on tally sheets. The child was then asked why the foods were placed together in that particular way, and the

labels the child gave to the groups were recorded — labels such as "fruits," "sweets," "breakfast foods," or "junk foods."

The food classification task was followed by an interview on the child's understanding of nutrients. The child was asked if s/he had heard of the terms "proteins," vitamins," "carbohydrates," and "fats," and, if so, to explain what they were. These technical terms, especially "carbohydrates," were chosen over more colloquial versions, because they are the ones found on food labels. This portion of the interview was tape recorded. The tapes were later transcribed, and a content analysis of the transcriptions was carried out.

Data Analysis

The data from the classification task were analyzed in three ways. First, a large tally sheet was constructed containing a listing of all the food groups created by the 115 children based on the labels the children gave to the groups. The percentage of children forming each of these groups was calculated. The placement into categories of selected foods of special interest to nutrition educators was noted — foods such as beans, potato chips, ice cream or eggs. Classification by such properties as shape, color, or meals was also noted whenever such systems were used.

Second, the placement of foods into groups was represented in a matrix in which each row or column represented one of the 71 foods, and each element within the matrix indicated the percentage of children who grouped a particular food with another food. In effect, the matrix encoded the degree of similarity of foods to one another, thus permitting use of appropriate multivariate statistical analyses. Cluster analysis was performed by the BMDP1M program (Dixon & Brown, 1979) using the maximum distance method

(Baker, 1974). Multidimensional scaling analysis (MDS) was performed by the INDSCAL method (Carroll & Chang, 1970). The rationale for these particular analyses will be provided in presentation of results.

The transcriptions of children's descriptions of the various nutrients were also analyzed. The responses were grouped into relatively simple categories according to the level of understanding that appeared to be demonstrated.

All of the above analyses were carried out separately for children at each of the three cognitive developmental levels -- pre-operational, early concrete operational, and late concrete operational thought -- in order to examine the influence of cognitive developmental level on the dimensions underlying children's food classifications and on their understanding of nutrients. Because the statistical or practical significance of group differences is, in some instances, difficult to determine in these data, only the more striking and suggestive findings of this nature will be reported. For example, a matrix of similarities of foods was calculated within each cognitive developmental level, and INDSCAL analysis included comparisons between groups. Due to limitations on the number of foods that could be analyzed by the multivariate statistical methods, 44 of the original 71 foods were selected for these analyses. The foods retained were ones that captured the variety of categories and dimensions as ascertained from preliminary multivariate analyses of the complete set of foods.

Results

The mean number of food groups formed by the entire sample was 8.7 with a median of 7.5 and a range of 2 to 20. About two thirds (65%) of the children formed 5-9 groups, and about one third (31%) formed 7-8 groups.

Food Categories as Described by Children

From the terms used by the children to describe their groupings, a classification scheme was developed. This scheme is shown in Table 1.

Insert Table 1 about here

Most (100) of the children used traditional semantic categories as criteria for placing foods into groups (e.g., fruits, breads, vegetables, etc.). Many (28-47) also used functional criteria (i.e. meals versus snacks) to place foods into groups (e.g. dinner foods, snacks). Criteria denoting evaluations of the nutritional quality of the food items were also used by many (49). The criteria of taste and texture were also used by a sizable number (39). Sweet items were included in this category only if the child actually used the word "sweet" to describe the group (as opposed to using words such as dessert or junk foods to describe them). The criterion of food likes or dislikes was used by only one child. It was striking that none of the children used nutrient terminology in describing the basis for classifying foods (e.g. "high protein foods"). The numbers in Table 1 add up to more than 115 because some children used more than one criterion for classifying foods.

The main categories formed by the children as labeled and reported to the interviewer are shown in Table 2. It can be seen that all the children formed a sweets group; 50% a fruits group; 50% a vegetable group (only 25%

Insert Table 2 about here

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formed a combined fruit and vegetable group while the remainder classified both fruits and vegetables with meals); 48% a drinks group; 24% a dairy group; and 20% a breads and grains group.

Additional classification findings are presented in relation to the traditional Four Food Group classification system, in Table 3. Children were found to violate this classification system in various ways, e.g., by never placing beans in the meat group, and never placing potato chips in the

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Insert Table 3 about here

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vegetable group but always with pretzels and/or crackers. Milk was classified with drinks 42% of the time, and ice cream with sweets 70% of the time. From these data it appears that some group designations corresponded with nutritionists' groupings (fruits, vegetables and meat) while others did not (sweets, snacks, beans, and drinks). In addition, many items (such as dairy, grains, and potatoes) were ambivalently classified under many different group designations.

<u>Cluster Analysis of Food Groupings</u>

The purpose of the cluster analysis was to identify recurrent groupings of foods on the basis of a defined multivariate data analysis procedure applied to data previously aggregated into a single matrix as described in the Methods section. Results of the clustering procedure were examined to identify the most encompassing groupings of foods and the next level of clusters within those groups. Eight of the latter clusters may be seen in Table 4: fruits, vegetables, meat, mixed foods, sweet foods, breads and

Insert Table 4 about here

breakfast foods, cheese and yoghurt, and drinks. Some of the clusters have quite high within-group similarity -- fruits have a median similarity index of 90 on a scale of 1-100; vegetables, medians of 67-81; meat and fish, medians of 79-85; and sweets and desserts, 65-67. Others had lower within-group similarity indices -- breads and breakfast foods (excluding breakfast cereals): medians of 43-64; mixed foods, 45-48; cheese and yoghurt, 43; and drinks, 52. These eight subgroups were clustered into four larger groups, but they were not the Basic Four Food Groups. As in results reported in Table 2, the fruits, vegetables, and meat groups showed the most correspondence with the nutritionists' classification system. Moreover, sweet items, again emerged as a distinct group. The hesitancy shown by children during the interview as to how to classify the remaining items -- the grains, breads, dairy, and drinks -- corresponds with the low within-group similarity indices for these clusters.

Multidimensional Scaling (MDS) Analysis of Food Categories

The INDSCAL MDS program was used to represent children's food groupings in dimensional fashion. As a consequence of the way the data were aggregated before input to INDSCAL, recurrent placements of foods into the same group are represented by locating foods near one another in the dimensional space. Conversely, foods placed in different groups are located at opposing ends of dimensions, and examination of these oppositions reveals the underlying bases of food classification. Furthermore, as a consequence of aggregating data separately at each cognitive developmental level,

INDSCAL provided information about differences among the three levels in dimensional perceptions of foods.

To determine the number of dimensions with which to represent the data, INDSCAL solutions were obtained allowing one, two, three, four and five dimensions, and the "variance accounted for" was examined for each solution. The one-, two-, three-, four-, and five-dimensional solutions accounted for 45%, 64%, 75%, 81% and 81% of the variance respectively. Because increasing amounts of variance were explained as dimensions 2 through 4 were included in the scaling solutions (but not with the addition of dimension 5), the four-dimensional solution was chosen to represent the data. Figure 1 shows the positions of the 44 foods on dimensions 1 and 2 of the four-dimensional INDSCAL solution.

Insert Figure 1 about here

Dimension 1 is seen in Figure 1 to distinguish foods such as candy, cookies and cakes from other foods, and is therefore interpreted as a dimension of sweet versus non-sweet foods. This interpretation accords with previous findings of this study. As indicated in Table 2, 100% of the children formed a "sweets" group, whether labeled as desserts, cakes, candy or sweets, and 25% of the children specifically labeled the group as such. Also, in the cluster analysis shown in Table 3, sweet food items are all clustered together and form a distinctive group.

Dimension 2 appears to distinguish foods on the basis of their functions as well as in their physical properties. A shorthand label for the dimension is meal entrees versus more versatile foods and drinks. The dimension corresponds in part with the findings given in Table 2, that 25-30% of the children classified foods by meal categories (appearing at the bottom of the figure) and 41% specifically created a breakfast foods category (containing some of the foods at the top left of the figure). However, physical properties also may underlie this dimension because drinks appear at the top extreme of the dimension. Figure 1 overall provides a triangular scheme, the points of the triangle containing (a) drinks and breakfast foods, (b) meal entrees with meat, and (c) sweet snacks.

Figure 2 shows dimensions 3 and 4 of the INDSCAL solution. Dimension 3

Insert Figure 2 about here

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appears to distinguish whole, fresh, less processed foods versus cooked, more highly processed foods. This is inferred not only from Figure 2 but also from the interview process itself where perceptually easily recognizable foods -- which also happen to be the whole, less processed ones, such as vegetables, fruits, and meat -- were the first groups to be formed. The other items were more problematic for children to classify, often leading to the proliferation of groups and subgroups and ambiguities as to where to place items (e.g. whether to place breakfast cereals with breakfast foods or with cereals and grains). In addition, mixed foods were often lumped together regardless of their constituents. This dimension also appears to include the notion of nutritional quality, because the less

processed foods tend to be higher in nutritional quality while the more processed foods tend to be lower in nutritional quality. Moreover, the less processed foods (e.g. fruits, vegetables) consistently had been placed by children in the "nutritious" categories, and the more processed ones (e.g. twinkies) in the "junk food" category.

Examination of the foods on opposite ends of dimension 4 suggests it is an animal versus plant dimension. While it is possible that this distinction was made because of nutritional differences in foods instead of a simpler distinction in the origin of the food, there is little evidence of this. Again in Figure 2 overall, a triangular pattern emerges, as a consequence of the fact that plant-originated foods vary in the degree of their processing while this is less true of animal foods.

Influence of Cognitive Developmental Level on Relative Importance of Dimensions

The INDSCAL program provided the additional information of the extent to which each of the four dimensions was in evidence in the data from each cognitive developmental level. Table 5 presents this information, expressed as the sensitivity or weight given by children in each group to each dimension.

Insert Table 5 about here

Relative to other groups, pre-operational children weight dimension 1 very highly (0.68), dimension 2 moderately (0.38), and the remaining dimensions only slightly (0.25 for both). Concrete operational children give dimension 1 less weight (0.51) than the pre-operational children, and

they give similar, though less, weight to the remaining three dimensions (.45, .39, and .35, respectively). The weights from late concrete-operational children differ little from early concrete-operational. Nevertheless, there appears to be a trend toward increasing weight on the last two dimensions with increasing cognitive development. While the weights on dimension 1 differ only between pre-operational and concrete operational children, the weights on dimension 2 do not differ sizably between any of the groups.

Understanding of nutrients

A summary of children's understanding of the terms "proteins," "vitamins," "carbohydrates," and "fats" is shown in Table 6. It should be noted that these are understandings as demonstrated in an open-ended individual interview setting. Settings in which cues are provided such as

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Insert Table 6 about here

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nutrition knowledge tests with multiple choice items may yield different results. Clearly, in this setting children demonstrated the most knowledge about vitamins and the least about carbohydrates. Their descriptions in general reflected only very simple understandings of nutrients. Proteins and vitamins were good for you and were often confused with each other, even by early and late concrete operational children. As one early concrete operational child commented, "'protein' is not a noun, you know; it's an adjective meaning 'good.' That is, 'protein' means 'good food.'" When directly asked, 40% of the pre-operational and 15% of the early concrete operational children stated that vitamins were found in pills only.

Fats were generally held to be bad, making one fat. Most children noted that fats are found in meat, and some mentioned milk. A few of the early and late concrete operational children mentioned that fats were reserve energy or were needed by the body. Few of the children knew much about carbohydrates. A few of the late concrete operational children thought it was something the body needs and thought it was associated with sugar and was bad for you. Two of the early concrete children's summary comments are revealing and fairly representative: "I have seen these words on cereal boxes before but I do not know what they mean," and "I have heard my mom and dad talk about these words but they are too hard to understand."

Discussion

Children's spontaneous classifications of foods, the dimensions underlying these classifications and changes in these conceptions with cognitive development have been described in some detail. The educational implications of these results depend, to some degree, upon their interpretation in relation to theories of cognitive development and the role of cognition in the dynamics of eating behavior.

Cognitive Developmental Theory

The change with cognitive developmental level in the relative importance of the four dimensions as the basis of children's classification judgments can be understood in terms of Piaget's developmental theory, especially the classification studies of Inhelder and Piaget (1964). According to these studies, pre-operational children either use resemblance sorting — whereby objects that resemble each other are placed together but different bases may be used for different groups of objects, or they may use consistent and exhaustive sorting — whereby all objects are grouped

together on the basis of one attribute but one which is based upon perception. With those limitations and frequent inconsistencies, this is pre-classificatory behavior.

Children then gradually develop the notion of class and class inclusion, i.e., the inclusion of one class within an enveloping or larger class of objects (A<B<C<D). This is called additive or hierarchical classification. Children also develop the ability to carry out multiple membership classifying, where an object can be placed into more than one class at one same time. Piaget calls this multiplicative classification. Both kinds of abilities develop simultaneously, because, according to Piaget, "they express one and the same general operational mode of organization" (1964, p. 290).

The act of classifying is a mental operation carried out on cognitive representations of objects and depends on the abstraction and retention of clear criteria. Since some kind of classification is necessary for organizing experience and is implicit in every judgment or inference, the ability to classify is essential for inferential or logical thought. The development of the ability to carry out true classification is thus a hallmark of operational thought. We will argue later that these abilities are necessary both to understand adequately the nutritional information communicated in educational programs and to act on this information in accordance with motivations to maintain health.

In accordance with Piagetian developmental theory, the pre-operational children in this study (generally the 5-6 year olds) appeared to classify foods on the basis of two perceptually concrete features of food -- sweet taste and liquid versus solid form. Associated with the latter dimension

was another relatively less abstract basis of classification -- function or occasion of eating foods, as meal entrees versus breakfast foods. The greater weight placed upon the sweetness dimension recalls Birch's finding (1979) that for preschool children (3-4 year olds) sweetness was a major salient dimension underlying their preference judgments. Those and other results from the present study indicate that sweetness is a major feature of food from preschool through elementary school ages.

The fact that concrete operational children in this study gave substantial importance to all four of the dimensions reflects the increasing cognitive abilities of these children, including abilities to carry out multiple membership classification. The most abstract dimensions, the third and fourth, appeared to require the more advanced cognitive abilities involved in identifying the original forms of foods prior to processing or production.

A cognitive developmental interpretation was also made by Worsley (1980) in a factor analytic study of secondary school and college nutrition students' perceptions of foods. The nutrition students' ratings of foods on a series of bipolar scales were seen as corresponding to some degree with professional food grouping systems, although other criteria than nutrient composition were pervasive. Secondary school students specifically emphasized evaluative criteria (good/bad, fattening) and preference (liking) and this was interpreted as reflecting an adolescent tendency toward figurative or egocentric thought. In a study by Morton (cited in Worsley, 1980), using multidimensional scaling with 14 foods, some relatively abstract or "advanced" conceptions were evidenced in ratings by adult laypersons and nutrition students. In particular, "nutritive value" was

identified as one of the four dimensions. Morton's remaining dimensions, "place of food in the menu," "sweet/savory" and "color" are, in two of these instances rather like the dimensions of the present study. However, neither the Worsley nor Morton studies explicitly assessed the cognitive developmental level of their respondents, and neither used as large or systematic a sample of foods as the present study. In the only prior study using a broad sampling of food stimuli and a grouping task (Campbell, Roe & Eickwort, 1982), data analyses were designed for somewhat different purposes (to investigate nutrient intake in relation to objective and subjective food grouping systems), and cognitive development was not examined in the adult sample.

Because cognitive developmental theory has served to explain results of the present study, some of its further implications deserve consideration. In particular, the theory suggests that many abstract concepts in nutrition cannot be learned until sufficient cognitive development has occurred. Indeed, Lawson and Renner (1975) found that the more abstract concepts in science were better understood by more cognitively advanced students. Thus nutrition education curricula for pre-operational children might be most effective if based upon or organized by concepts demonstrated to be available to these children, such as sweets versus non-sweets and meal entrees versus beverages and breakfast foods. As children develop understandings of class and class inclusion, the notion of nutrients could be introduced, for example, through a discussion of food processing and its effect on the nutrient content of foods. It is important to note that the present results do not completely rule out the possibility that children at any of the cognitive developmental levels have the <u>capacity</u> to learn

abstractly about nutrients and existing food grouping systems. Perhaps the only way to determine whether this capacity exists would be to implement intensive training to the various cognitive developmental groups, using a variety of approaches and evaluating whether understanding of abstract concepts occurred in all groups. However, the theoretical and empirical observations in this paper suggest that such attempts among the less developed persons are not likely to be terribly successful. In any case, it may be much more practical to use naturally occurring conceptualizations as the basis for instructing students of different levels about health-related consequences of food choices, and the present study revealed major aspects of these conceptualizations.

Motivational Analysis and Suggestions for Curriculum Design

Ultimately the purpose of practice and research relevant to health and nutrition education is to induce healthful behavior in the population. Drawing upon McGuire's (1969) work on attitude theories and research, Leventhal and Hirschman (1982) described a "step" model of communication that provides a useful perspective upon the relation of the present research to behavioral health (Matarazzo, 1982). The early steps in the model concern aspects of the message to be communicated and whether it is received, understood, and remembered by the audience. The remaining steps, concerning accepting the message (with attendant attitude change) and changing behavior, require that the earlier steps have been passed. Previous discussion has detailed dimensions of understanding of foods and has identified cognitive development as a factor likely to influence whether messages will be understood and how they might be designed for better understanding. Thus from this perspective, successful education would

"enable" beneficial behavior change (cf. Green, Kreuter, Deeds, & Partridge, 1980, describing additional "enabling" factors).

The research reviewed by Leventhal and Hirschman (1982) in relation to the step model makes a further point, that behavior change is facilitated as the message tells particular behaviors that will lead to the health enhancement goal of the educational program. Thus even the more cognitively advanced children, who are able to understand abstract nutritional concepts, need concrete information about particular foods to eat in order to satisfy nutritional and health needs. The use of specific food guides in nutrition education is in accord with this notion. However, to maximize the effectiveness of the food guide approach, the group membership of any food should be readily recognizable, and the goals served by selecting particular foods should be clear.

The theoretical perspective holding that people draw upon their general and specific knowledge in order to accomplish health enhancement goals is elaborated in self-regulation models of motivation (Carver & Scheier, 1982; Leventhal, Nerenz, & Strauss, 1980). These models express aspects of values, knowledge, skills and other factors involved in the process of adjusting behavior to achieve whatever goals the person may hold. In the present context, such goals may include illness prevention and health promotion, perhaps in combination with effort minimization, pleasure maximization, and other desired outcomes. Indeed, without undue distortion, many of the longstanding models of health behavior appear related to this view, including models concerning particular goals as predictors of behavior (e.g., threat reduction and profitable reward/cost outcomes -- Becker, 1974) or more general decision-making processes (Kolbe, Iverson, Kreuter,

Hochbaum, & Christensen, 1981). The related, traditional perspectives on human motivation (e.g., Lewin, Dembo, Festinger, & Sears, 1944) further draw out the distinction in determinants of behavior, between the goals or ends toward which behavior is directed, and the learned behavioral repertoire that the person expects will yield the desired outcome.

Psychologists may contribute to the development of food guides and other health education materials by detailing the motivational and cognitive underpinnings of particular health behaviors, and suggesting ways of linking desired outcomes with professionally recommended behaviors. In Leventhal and Hirschman's terms, "If we are to teach people or have people teach themselves the art of prevention or how to regulate their behavior toward optimal health goals, we must be able to articulate what these goal states are, specify action sequences that can be used to achieve these goals, and provide abstract labels or justifications for this process" (1982, p. 212). This task clearly requires contributions from several related fields, including specializations in the relevant health behavior (e.g., nutrition), and education, as well as psychology. Ideally the collaborative work would integrate what is known about current behavioral patterns and their health related consequences with theoretical and empirical bases for inducing behavioral change. In the remainder of this section, we will attempt to illustrate some of the ways in which future nutrition education curricula might incorporate these principles and findings from this study.

Precisely how links are to be made between outcomes and behavioral recommendations may depend on the cognitive developmental level of the audience. For example, because sweetness appears to be very salient to children, nutrition education could discuss the consumption of sweet items

in terms of their relationship to dental caries, and possibly, obesity. This strategy seems especially important with the pre-operational children because they placed greatest emphasis on sweetness. The less cariogenic and less calorie-dense items within the sweets category could be pointed out and their consumption encouraged.

As children develop and the meal vs. other foods dimension becomes more salient, the consumption of meals could be linked to its role in growth, body development and good health in general. According to the National Food Consumption Survey (Pao & Mickle, 1980), about 60-70% of children of this age snack and snacks contribute 20% of their daily caloric intake. The Bogalusa Heart study, based on a much smaller sample but in-depth interviewing, found that 95% of the children snacked and that these snacks formed about 34% of their daily intake — indeed, a greater source of calories than any of the individual meals (Frank, Berenson, & Webber, 1978). About 50% ate 5 to 9 times a day, and 25% more than 9 times. The remaining 25% ate fewer than 5 times daily. Clearly, then, the nutritional quality of snacks is of considerable interest. Thus, the contribution of snacks to health should be discussed in educational programs, and food guidance should not only encourage the consumption of appropriate meal items, but also assist children to distinguish which snacks to eat and which ones to avoid.

In nutrition education with concrete operational children, for whom the dimensions of degree of processing and animal versus plant appear to be quite salient, the latter dimensions could be linked with additional health consequences of eating these different kinds of foods. In light of the increasing knowledge about the relationship between various dietary components and health (American Society for Clinical Nutrition, 1979;

National Research Council, 1982) and the increasing concern about the diets of children (Dwyer, 1980), nutrition education content should include the importance of whole foods and minimally processed foods, especially those of plant origin. Concerns about fat in the diet may also be introduced at this time, because it appears from our interviews that children are able to identify fat as being associated with certain foods such as meat and milk, and because these two food categories are the major contributors to the fat in diets of children according to Dwyer's (1980) analysis of the HANES data. Furthermore, the idea of a balanced diet could be emphasized, with "balance" referring to the appropriate apportionment of amounts in the diet of highly processed and minimally processed foods, plant and animal foods, and meal items and snacks.

Food Guides in Nutrition Education

A food guide is the major tool used by nutritionists to convert the linkages between foods and their health effects into useful guidelines about how much of what to eat. The Four Food Groups guide was designed 25 years ago primarily to ensure that people using it received enough protein and the major vitamins and minerals — the health problems of the time. This guide has come under considerable criticism in recent years for its failure to address the current diet-related health problems of our population in light of current dietary practices. For example, dental caries are a prevalent finding among children in the U.S. (Kelly & Harvey, 1979) and food items containing sugars are an important part of children's diets (Pao, 1980), contributing some 25% to total daily caloric intake (Cala, Morgan & Zabik, 1981). Bakery products, soft drinks, and milk desserts are the most frequently consumed snacks (Kelly & Harvey, 1979). Yet in the current Four

Food Group system, sweet items are either relegated to the left-over miscellaneous group (e.g. soft drinks, jams), or are subsumed into other groups (for example, milk desserts into dairy group, or bakery products into the cereals group) where they are not distinguished from other items in the group. That is, no special instructions are provided in this system for a class of items that is so conspicuous in children's diets, and so prominent in children's classification judgments in this study.

Furthermore, Contento's (1981) review of grades K through 6 nutrition education indicated that educational programs based on the Four Food Groups generally are unsuccessful in changing eating behavior. They do improve children's ability to select, on paper, hypothetical meals based on the Four Food Groups, but the failure to influence behavior suggests that the full sequence of steps and prerequisites in the communications and self-regulation models are not satisfied in the traditional approach. More promising is the approach taken in a study by Coates, Jeffery and Slinkard (1981). Children in grades 4 and 5 received instruction over 12 class periods about "Heart Healthy" foods. The first four topics in the educational program were presented in terms designating occasions or functions of eating: snacks, breakfast, lunch and dinner. These topics correspond with categorizations that the present study suggests would be appropriate to pre-operational and concrete operational children in these grades. The remaining two topics, "shopping, how to read labels" and "summary - fat, sugar, salt, cholesterol, and the heart" seem more appropriate to the more cognitively advanced children. Findings demonstrated that this approach was successful both in increasing knowledge and inducing more healthful eating during the period of evaluation.

In conclusion, the findings of this study suggest that food guides to be used with children should take into account not only the current eating patterns of children, but also ways to link aspects of food to health outcomes that are developmentally appropriate and that connect with the motivations of the learner. Of the several new guides that have been suggested in recent years to address more adequately today's nutritional issues (e.g., Dodds, 1981; Lachance, 1981; Pennington, 1981) the guide suggested by Pennington additionally appears to take into account many of the features of food that this study has found are salient to children. The guide, in outline, is an inverse pyramid, which recommends sparse consumption of sweet items (and fats and alcohol) — located in the apex of the inverse pyramid; moderate consumption of animal foods -- located in the center of the inverse pyramid; and liberal consumption of plant foods — located in the base of the inverse pyramid (i.e., on top). Animal foods are subdivided into high and low fat varieties, and plant foods are subdivided more or less on the basis of their degree of processing. Pennington believes that the "guide is simple enough to be understood by children" (1981, p. 55) and the findings of the present study suggest that this may be so. Obviously, the actual usability of the guide should be tested with children, and this or other guides should be modified accordingly to utilize present and future information about children's concepts and behavior regarding food.

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Footnotes

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Table 1

Criteria Used by Children to Classify Foods

Classes Formed	Members	Frequency
1. Traditional semantic categories	e.g. fruits, meats, vegetables, breads, candy, desserts and others	100
2. Functional categories	. . . .	140
	breakfast items	47
	lunch items	28
	dinner foods	35
	snacks	29
	main course foods	1
3. Nutritional quality	. . . .	49
	"junk" foods	26
	"nutritious" foods	11
	good/bad	9
	healthy foods	2
	cavity foods	1
4. Taste/texture	. . . .	38
	sweet or sugary foods	29
	crunchy/crisp	3
	hard/soft	3
	slimy	1
	fatty/greasy	1
	cold/hot/wet	1
5. Food unknown or never tasted	. . . .	18
	pinto beans	8
	beets	5
	bagels	5
6. Preference	like/dislike	1
7. Miscellaneous	. . . .	7
	foods made with milk	1
	party foods	1
	things that will melt	1
	baked things	1
	foods that go in the refrigerator	1
	foods to eat when it is cold outside	1
	salty things	1

Note. The maximum frequency in each class is 115, and frequencies add up to more than 115 because children each used more than one criterion for classifying foods.

Table 2

Major Food Categories Formed by Children

Groups formed	Percent of children forming each group	
Sweets	100	
All sweet items = 1 group		70
Two groups: desserts, candy		30
Meat and fish	70	
Meats and fish alone		34
Meats and fish with stews, sandwiches		36
Fruits	51	
Vegetables	50	
(Fruits and Vegetables together)	25	
Drinks	48	
(Milk in drinks group)		36
Dairy	48	
Milk, cheeses, yoghurt		24
Cheeses only (milk, yoghurt in other groups)		24
Breads	32	
Grains		
Breakfast cereals only (no other grains or bread)	19	
Starches (rice and noodles)	30	
Starches and breakfast cereals	6	
Breads and grains	20	
Meals		
Breakfasts	41	
Lunches	24	
Dinners	30	
Snacks	25	

Note. Percentages are calculated over the total sample of 115 children.

Table 3

Children's Classifications of Foods of Special Interest for their Nutritional Significance

FOOD	Group designation of food (percent distribution)	FOOD	Group designation of food (percent distribution)
Milk, regular, was classified		Beans were never classified with meat	
With drinks (O.J., soda)	42	With vegetables	75
With dairy, various	30	Alone	25
With meals	18	Potatoes	
Others	10	With vegetables	46
Milk, chocolate, was classified		With dinners	26
With drinks (O'.J., soda)	54	With grains and starches	11
With sweets	19	By itself	10
With dairy	15	Others	7
With meals	11	Potato Chips	
Ice cream was classified		With sweets in "junk" group	29
With sweets	70	As snacks with other non-sweet snacks	31
With dairy, various	27	In grains group	19
Others	3	By themselves	17
Cheese was classified		Others	4
with meals	38		
By itself	24		
With dairy, various	24		
With "good foods"	8		
Others	6		
Yoghurt was classified			
With dairy or cheese	33		
With sweets	23		
With meals	12		
Others	32		
Eggs were classified			
With breakfast foods	40		
By itself	20		
With dairy	12		
With meat	7		
With "good foods"	7		
Others	14		

Table 4

Children's spontaneous food classification groups obtained from cluster analysis

	Within subgroup	Within group	Fruits	Vegetables	Meat, fish	Mixed foods	Rice and noodles	Candy and desserts	Breads	Breakfast cereals	Waffles and eggs	Cheese and yoghurt	Drinks
Fruits	90	46		29	5	9	5	8	6	5	8	10	8
Vegetables	78		29		14	17	20	2	7	5	9	12	5
Potatoes	81												
Beans	67												
Meat	85	36	5	14		33	16	1	8	3	4	11	6
Fish	79												
Sandwiches & mixed foods	48		9	17	33		32	3	14	8	13	11	8
Rice & noodles	45.5		5	20	16	32		4	18	17	13	11	4
Cakes & Desserts	67.5	57	8	2	1	3	4		10	9	9	10	10
Candy, ice-cream, snack	65												
Breads	64	21	6	7	8	14	18	10		35	24	16	9
Breakfast cereals	88.5		5	5	6	8	17	9	35		44	16	13
Waffles & eggs	43		8	9	4	13	13	9	24	44		14	13
Cheese & yoghurt	43		10	12	11	11	11	10	16	16	14		21
Milk, O.J. & soda	52		8	5	6	8	4	10	9	13	13	21	

Values in the table are medians on a siimilarity index with a scale of 1 to 100. Each value represents the percent of times any two foods were placed in the same group by respondents.

Table 5

Weighting of INDSCAL MDS Dimensions

by each Cognitive Developmental Group

Cognitive Developmental Level	Dimensions Obtained from INDSCAL MDS Analysis			
	1	2	3	4
Pre-operational children	.68	.38	.25	.25
Early concrete-operational children	.51	.45	.39	.35
Late concrete-operational children	.51	.38	.44	.41

Table 6

Children's understanding of nutrients as obtained from the open-ended interview

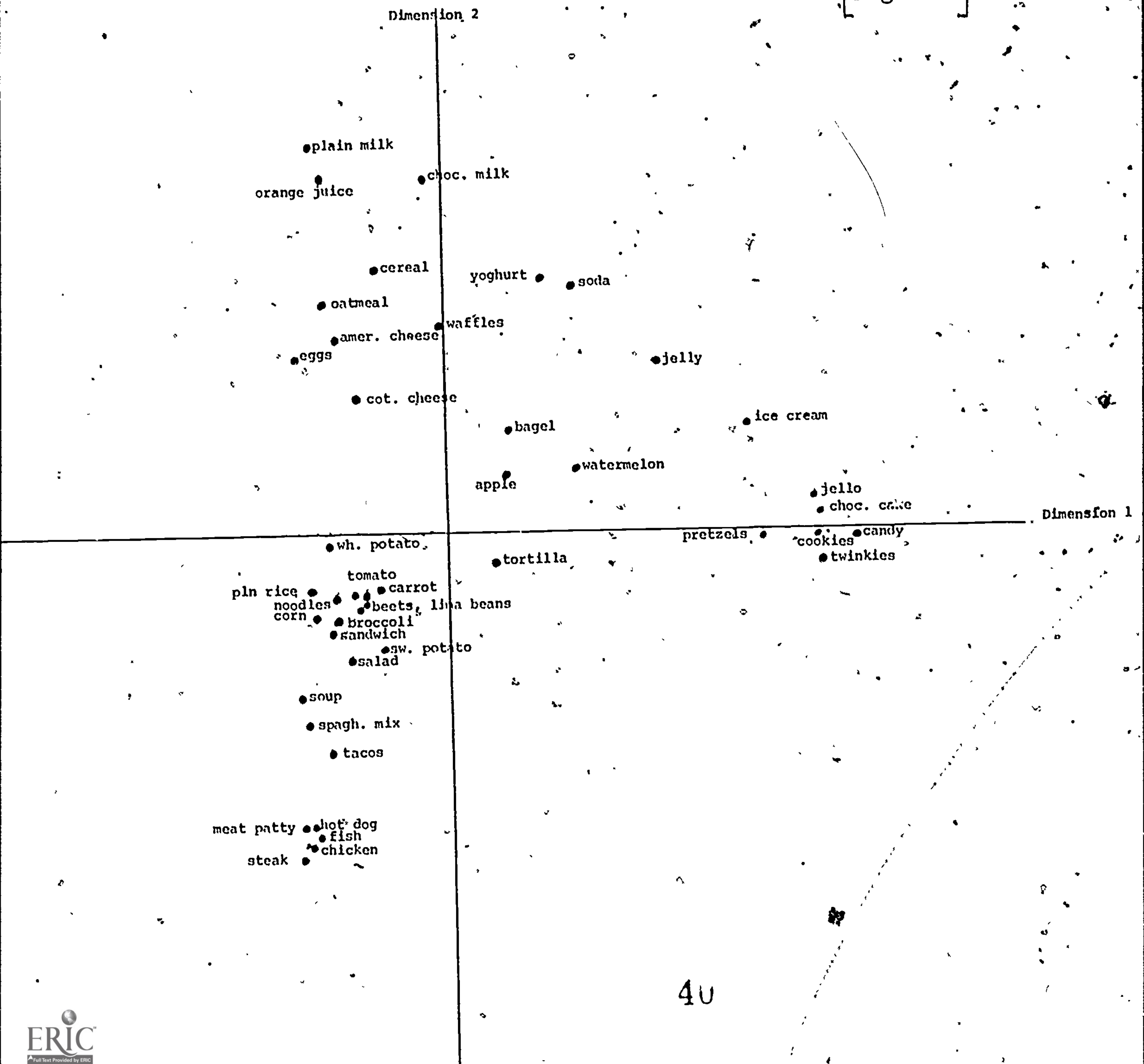
NUTRIENT	LEVEL OF UNDERSTANDING			
	"Don't Know"	"Know" (% of subjects)		
Cognitive developmental level	(% of subjects)	Simple Descriptions (e.g. good/bad, food sources)	More complex descriptions	
PROTEIN				
Pre-operational	60	22	7	keeps you healthy
Early concrete	36	39	25	gives energy; helps you grow; is a vitamin
Late concrete	37	26	37	body needs; gives health, energy, like vitamin
VITAMINS				
Pre-operational	0	80	20	keeps you healthy; different colors/shapes
Early concrete	0	74	26	keeps you healthy; have proteins and iron
Late concrete	0	67	33	keeps you healthy
CARBOHYDRATES				
Pre-operational	100	0	0	
Early concrete	78	11	11	something you drink, sugar; put into food-bad
Late concrete	64	14	22	body needs; sugar; stuff from grains/cereal
FATS				
Pre-operational	40	60	0	are fat people; bad
Early concrete	36	36	28	makes you fat; body needs; reserve energy
Late concrete	7	60	33	makes you fat; body needs; reserve energy; "it's a lot of calories in food"

Figure Captions

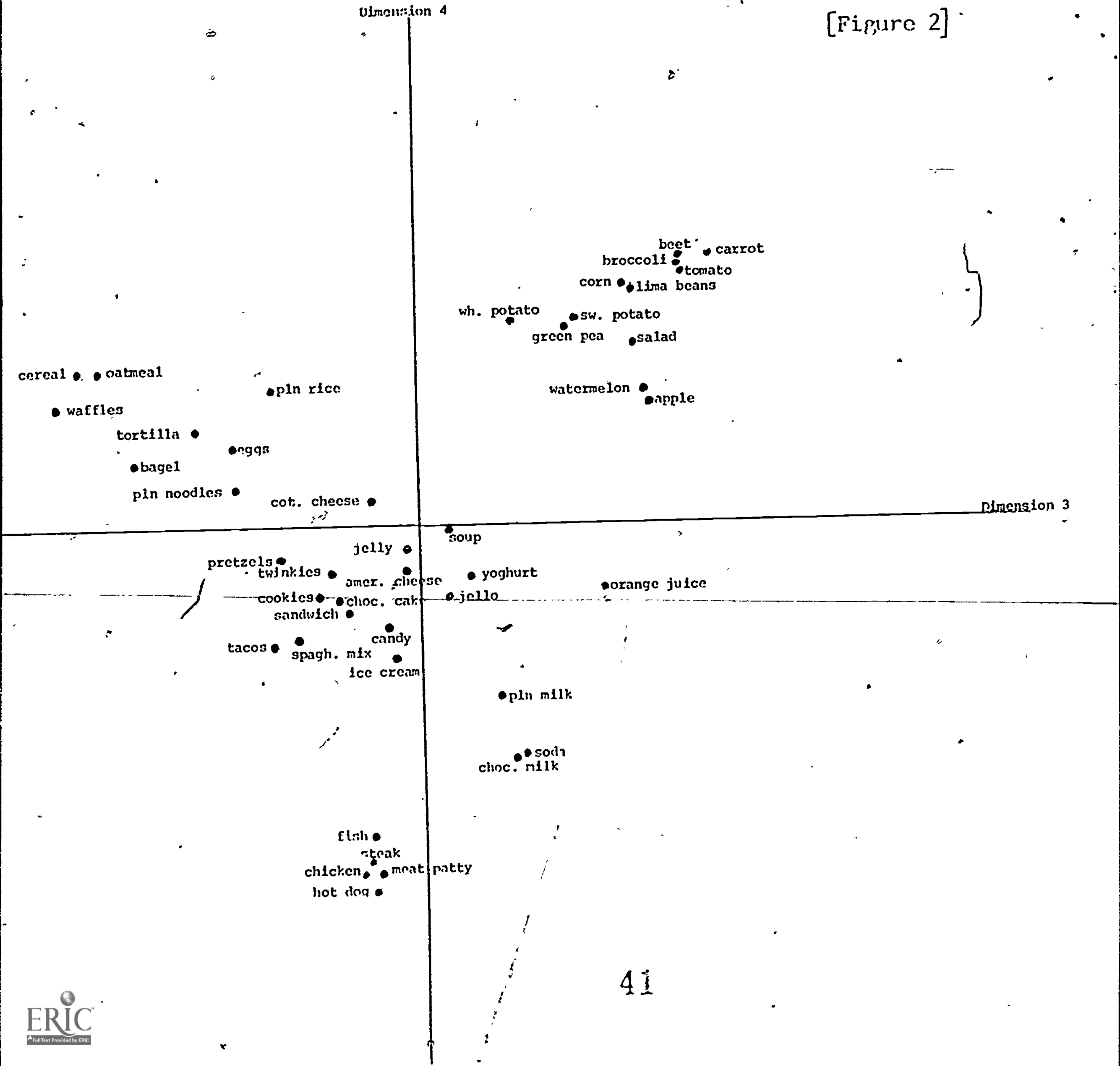
Figure 1. Positions of foods in the space defined by the first two dimensions of the INDSCAL multidimensional scaling (MDS) solution.

Figure 2. Positions of foods in relation to the third and fourth dimensions of the MDS solution.

[Figure 1]


Dimension 2
Dimension 1
plain milk
orange juice
choc. milk
cereal
yoghurt
soda
oatmeal
waffles
amer. cheese
eggs
jelly
cot. cheese
ice cream
bagel
watermelon
apple
jello
choc. cake
pretzels
cookies
candy
twinkies
wh. potato
tortilla
tomato
carrot
pln rice
noodles
beets
lima beans
corn
broccoli
sandwich
sw. potato
salad
soup
spagh. mix
tacos
meat patty
hot dog
fish
chicken
steak

[Figure 2]



Dimension 4
Dimension 3
beet
carrot
broccoli
tomato
corn
lima beans
wh. potato
sw. potato
green pea
salad
watermelon
apple
cereal
oatmeal
pln rice
waffles
tortilla
eggs
bagel
pln noodles
cot. cheese
soup
jelly
pretzels
twinkies
amer. cheese
yoghurt
orange juice
cookies
choc. cake
jello
sandwich
candy
tacos
spagh. mix
ice cream
pln milk
soda
choc. milk
fish
steak
chicken
meat patty
hot dog