The Effects of Three Instructional Strategies on the Food Group Labeling Responses in Preschool Children

Jon Jeffery Boes
Western Michigan University

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THE EFFECTS OF THREE INSTRUCTIONAL STRATEGIES ON THE
FOOD GROUP LABELING RESPONSES IN PRESCHOOL CHILDREN

by

Jon Jeffery Boes

A Project Report
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Specialist in Education
Department of Psychology

Western Michigan University
Kalamazoo, Michigan
August 1982
THE EFFECTS OF THREE INSTRUCTIONAL STRATEGIES ON THE FOOD GROUP LABELING RESPONSES IN PRESCHOOL CHILDREN

Jon Jeffery Boes, Ed.S.
Western Michigan University, 1982

This study compared three Direct Instruction procedures for teaching the labeling of food in terms of the five basic food groups (fruits, vegetables, meats, grains, and dairy products). Eighteen preschoolers served as subjects. They were randomly assigned to three experimental groups and a control group. The experimental group was assigned to one of the following instructional procedures: (1) Generative I, (2) Generative II, (3) Generative III. The sets of exercises in the procedures were taught as one track in a Direct Instruction program designed to teach nutrition knowledge. All other exercises in the program were identical for the three experimental groups. The results indicated that all three procedures taught the subjects to accurately label the food groups introduced. However, the Generative III procedure taught the labeling responses in a shorter period of time. The control group showed no gains. The results suggest that generative procedures may be useful in teaching large noun classes containing members sharing few visual features.
ACKNOWLEDGEMENTS

I would like to acknowledge the guidance, expertise, and assistance of Michael F. Masters during the construction, implementation, and write-up of this project. Without his help, this project would not exist in the form it is now.

In addition, I would like to thank Dr. Galen Alessi for serving as the overwhelming source for my repertoire in school psychology. Dr. Alessi was also very instrumental in the final product of this project.

I sincerely thank you both!

Jon Jeffery Boes
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CHAPTER I

INTRODUCTION

The present study sought to evaluate the effects of three instructional approaches, including three generative teaching formats, on food group labeling responses in preschool children. Each of the instructional approaches used Direct Instruction strategies to teach the concepts of the various food groups but differed in terms of the presentation of examples to teach the concept.

Engelmann describes a concept in the following manner: "the set of characteristics shared by a set of instances in a given universe and not shared by other instances in that universe." (cited by Becker 1974 p. 303). A basic tenet of the Direct Instruction approach includes teaching concepts in a generative manner. That is, designing the format for teaching a concept so that maximum stimulus control within the concept class can be produced by presenting the minimum number of concept instances. This requires both a careful selection of the specific concept instances to be presented, as well as a carefully prescribed sequence for presenting these instances.

Alessi (1979) describes five important guidelines for the proper presentation of a concept in a Direct Instruction manner. First, it is extremely important to teach one and only one concept at a time. This avoids confusion and ensures that the format for teaching is not ambiguous. After a basic concept is taught, it may be integrated with others already learned.
Second, positive examples of the concept must show the complete range of the concept. The examples must include all initial features of the concept and not show a limited range along critical feature dimensions. Otherwise, the child might be expected to make errors of undergeneralization. For example, when teaching the concept "circle," the examples would include which would differ in size, color, and on other relevant feature dimensions. This would increase the probability that the learner would correctly respond to the critical features of "circle;" and not respond to the irrelevant features.

The third guideline includes the proper use of negative examples in a teaching format. When pairing or juxtapositioning a negative with a positive example, it is critical that the examples be minimally different, and only for the stimulus feature that is critical for discriminating positive from negative examples. A negative example which is thusly minimally different shows the precise limits of the positive example range and rules out the greatest number of irrelevant concept features (i.e. all features shared by both positive and negative examples must be irrelevant to effective differential responding). For example, when teaching "circle" a minimally different example would be the side by side presentation of a blue circle and a blue square - both being the same dimensions: color, area, thickness, and made of the same material. This would decrease the probability that the learner would come under the control of an irrelevant feature (color) and, thus, make errors of overgeneralization that all circles are blue (or blue is a critical feature of "circle"), since the positive and negative examples pre-
sented were identical in all instances except shape.

The fourth guideline deals with the wording used in teaching a concept. It is essential that initial teaching of a concept be as precise and simple as possible to avoid confusion. Thus, throughout the teaching format, wording should be the same across all juxtaposed examples. After the learners are firm or know the concept as a result of initial instruction, the wording may be expanded.

The fifth guideline concerns the use of examples within the teaching format; this is called the set-up. The format should teach with the fewest number of examples in the initial teaching lessons to avoid confusion. Moreover, the examples, both positive and negative, should be juxtaposed as closely as possible in time and space. After initial firming of the concept, the format may be expanded to increase generality of the concept across changes in wording, types of examples, and contexts.

These five principles serve as the basis for the Direct Instruction model for teaching in terms of example selection and sequence for presentation of examples.

The Direct Instruction model came into prominence from Project Follow Through (Becker and Carnine, 1976; Becker and Carnine, 1981). This federally funded study compared the effects of nine instructional approaches on the academic skills of economically disadvantaged children across the country. The Follow Through study demonstrated that Direct Instruction can be an effective instrument to increase language, reading, and mathematics skills for children (Becker and Carnine, 1980; Becker and Carnine, 1981; Becker and Engelmann, 1978).
Based on Follow Through and subsequent studies, researchers collected data on the various unique components of the Direct Instruction program. Instructors incorporate hand signals into instruction which promotes unison responding in small groups of students. Research indicates that the use of signals (Carnine and Fink, 1976; Cowart, Carnine and Becker, 1976) and overt unison responding (Fink and Becker, 1976) increase academic performance as opposed to individual or covert responding.

A fast rate of presentation is another instructional component which the Direct Instruction model uses to increase skill acquisition. Research indicates that a high rate of instruction increased participation rate, correct responding rate, and decreased off-task behavior as compared to a low rate of presentation (Carnine, 1976; Massad and Etzel, 1972).

Contingent praise for correct responding is another crucial component of the Direct Instruction model. Couched within the educational setting, teacher praise decreased inappropriate behavior (Madsen, Becker and Thomas, 1968; Thomas, Becker and Armstrong, 1968).

Systematic and specific corrections of student errors in responding is another important dimension in the implementation of the Direct Instruction approach to teaching. Carnine (1976) found that such corrections increased accuracy on training questions 55% as compared to instruction without systematic corrections.

The present study incorporated all of the aforementioned techniques across all three teaching approaches. Moreover, the study instructed the subjects in small groups (Fink and Carnine, 1975) as
opposed to large group or individual instruction.

The present research used other Direct Instruction strategies across all three experimental groups. These programming techniques included the sequencing of examples (Stolurow, 1975), use of a dynamic presentation (Carnine, 1978), and juxtapositioning of minimally different positive and negative examples (Gradzin and Carnine, 1977).

The amount of research on the effectiveness of the generative approach is limited. Low Stress Algorithms (Alessi, 1974; Hutchings, 1972) in addition, subtraction, multiplication, and division operations are examples of a generative approach applied to mathematics. For example, Low Stress techniques allow children to calculate sums to any size addition problem by using only operations on the 100 basic addition facts. Low Stress does not require knowledge of the 900 complex addition facts, nor regrouping operations, which are necessary with the traditional addition algorithm. Therefore, Low Stress yields the maximum range of addition competence, by teaching the fewest number of skills.

Carnine (1977) demonstrated that phonic based instruction (i.e. a generative approach) facilitated learning of decoding skills over a meaning emphasis program or sight reading. Phonic based instruction focuses on teaching some 40 sound-letter associations plus blending, which yields decoding capability of 300,000 words in the English language. By contrast, sight reading is a linear additive form of instruction which focuses on teaching almost every member of
the decoding universe (e.g. teaching "cat" as a sight word rather than teaching the letter's sound). Sight reading has some generative power, such as a child learning the words "foot" and "ball", and putting them together to read "football." But the power is basically limited to compound words and some consistent morphemes (e.g. "-ed," "-ing," "re-").

Carnine (1977) demonstrated that a generative approach was effective in teaching preschool and college students a concept along a continuum. Subjects' received instruction on a concept (called "tat") which was a cardboard geometric form with five to eight points. The researcher presented positive examples of the concept and both ends of the continuum (i.e. with five or eight points) and minimally different negatives (i.e. with four or nine points). All subjects responded correctly to subsequent novel examples (with five and eight points). The instruction was generative in that it presented only examples at either end of the continuum of the concept as positive examples and presented negative examples that were minimally different. The subjects then identified novel examples correctly by interpolating all examples within the range as positive, and extrapolating all examples outside that range as negative, as demonstrated in the research teaching sequence.

Concepts generally fall into two types: those which each member shares only one critical feature, and those in which members share multiple critical features (i.e. conjunctive concepts). That is, single feature concept examples can be changed into negative
examples by changing only one variable or feature, while conjunctive concept examples may be changed into negative examples by changing any one or more of several features. Some of the negative examples created would not be actual objects, thus, presenting the programmer with a dilemma concerning which negative examples to use. Also, since several features are involved, it becomes awkward (if not impossible) to show the precise features (and their ranges) which define the concept boundary.

Engelmann refers to conjunctive concepts as "nouns" (Engelmann, 1981). When programming instruction on multiple feature concepts such as nouns, instruction in a generative manner becomes increasingly difficult. For example, it is very difficult to use the set-up principle when teaching noun concepts, since there is usually no precise way of changing positive into negative examples by changing the critical feature(s). Engelmann exemplifies this point when explaining the programming difficulties in constructing an instructional strategy for the concept "shoe." "Even if we tried to specify a 'definition' or classification criterion for shoe that seemed totally precise, we would discover that we could create examples that are ambiguous because examples at the boundary lines can't be clearly classified. So it is with all nouns. The implication for instruction is that we should not try to create a precise boundary line when very knowledgeable adults do not agree on one." (Engelmann and Carnine, 1982, p.55).

This is certainly the crux of the problem for the present study.
Instruction in the Present study focused on teaching of the basic food groups: fruits, grains, meats, vegetables, and dairy products. These are multiple feature (noun) concept classes which must be dealt with in a special manner because of problems in generating minimally different examples. The problem is dealt with by using Engelmann's strategy (Engelmann, 1982) of selecting minimally different negative examples from examples the student already knows, rather than from the entire universe of potential examples. This modification helps alleviate some of the instructional problems arising from the lack of a clean set-up application (i.e. the strategy of juxtapositioning positive and negative examples of the concept that differ only in one feature and, thus, cueing that feature as critical for the learner's differential response).

Thus, the present study attempted to evaluate the most effective of these instructional approaches in teaching the basic food groups. The research evaluated three types of generative instruction: Generative I, Generative II, and Generative III.
CHAPTER II

METHOD

Subjects

There were a total of 18 subjects: 13 in the experimental group and 6 in the control group. There were eight males and ten females with ages ranging from 3.2 to 4.5 years. All subjects attended a preschool which emphasized accelerated acquisition of academic and social skills.

The subjects were selected by two criteria. First, the students had a history of five day per week attendance during the scheduled experimental sessions. Second, they had to be currently enrolled in or have completed Distar Language I (Engelmann and Osborne, 1976). Distar is an acronym for Direct Instruction systems for teaching and remediation. The language program focuses on teaching basic concepts and responding to teacher directions. It also serves as a foundation for subsequent responding using the Direct Instruction model.

The students were randomly assigned to three experimental groups, using a random number table.

The experimenter did not form a control group from the same pool as used for the experimental group, due to the small number of subjects who met the academic criteria and attended at the time of the experimental sessions. The experimenter selected control subjects who met the academic criteria, but did not attend at the time.
of day of the experimental sessions. This schedule of attendance was the only known difference between students in the experimental and control groups.

Setting

A research oriented preschool supported by Western Michigan University, located in Kalamazoo, Michigan, served as the location for the research. The administration and supportive staff at the center consisted primarily of undergraduate and graduate psychology students attending the university.

The children in the study received instruction in one of two rooms within the preschool. The first classroom was approximately 9 by 12 meters with linoleum floors and cinder block walls. The room has two sets of chairs in opposite corners, arranged in semi-circles, and facing their respective corners. The instructor's chair faced the subject's chairs. The second instructional area was 12 by 15 meters with a carpeted floor and cinder block walls. Both rooms were unused classrooms which had adequate ventilation and lighting for instruction. Also, both rooms had portable bookshelves which served as dividers for privacy during the small group instruction.

Materials

An integral component of the research was the incorporation of a structured presentation of teacher wording, teacher behavior, student responses, and pictured stimuli. Instructional formats facilitated
this component of the study. The scripts were specific to the three instructional methods employed in the research. The scripts ensured that instruction across all groups adhered to basic direct instruction principles, such as isolating one skill at a time and juxtapositioning minimally different positive and negative examples. Thus, to control the quality of the instruction and maintain a consistency in presenting the material, the program designers typed the specific teacher wording in upper case letters on 8½ by 11 inch paper. Also embedded in the format for instruction was the specific behavior or actions of the teacher which corresponded to the wording. The program designers coded teacher actions by typing them in lower case letters in parenthesis. To control for possible misrules or unclear criteria for the subject responses, the script provided the correct response in lower case letters.

The scripts also contained picture stimuli which served as examples and nonexamples of the taught concept. Instruction initially focused on teaching the discrimination of pictures which were foods from those that were not foods. Next, instruction focused on classifying foods as belonging to one of the five basic food groups. Finally, instruction centered on labeling a specific food item with it's proper name.

A professional artist drew the picture stimuli in black and white and then photocopied the drawings so that they could be directly pasted on the script. The researcher supervised student staff members who colored the pictures with colored pencils. The
stimuli corresponded with teacher wording mentioned above. The examples of specific food types varied across lessons, having three different variations of each food type incorporated into instruction.

In summary, the scripts typically had teacher wording, teacher actions, and student responses typed on the left side of the paper and picture stimuli on the right side. The researcher placed the finished scripted formats in clear plastic page protectors and inserted them into a ringed folder for both the protection of the scripts and ease in presentation of the materials.

The researcher constructed a pretest and posttest to measure gains from instruction. The tests were constructed from the same materials mentioned in the above section for programmed scripts - 8½ by 11 inch paper with plastic page protectors in a ringed folder. The tests contained all of the food groups taught in the instructional phase of the project plus five vegetable, four meats, and two fruits not presented in instruction. The pages consisted of three rows of three picture stimuli, with no direction for wording or teacher actions. The test had a total of 45 stimuli on five pages. Student staff administered the tests. They received instructions, both verbal and written, on the administration of the tests. The researcher designed the protocol to record the students' responses to the tests. The protocols were simply a dittoed list of the stimuli corresponding to the picture which had the foods' proper name and the food class for that food. The researcher segregated items on the protocol by placing a solid double line between those items found on one page of the picture stimuli to those found on the next page.
(see Table 1).

Staff Instructors

Instructors for the study were two male and seven female undergraduate psychology students. The instructors were juniors and seniors and had at least basic knowledge of the Direct Instruction model. Training was on three levels. First, the instructors received literature regarding various theoretical and technical aspects of direct instruction. One week after receiving the material, the instructors' received a written test on the material on which they had to score at least 90% to proceed to the next component of training. Next, they individually role played (using simple scripted formats) with the writer serving as the student/subject. The formats used in this component of training were from Distant Language I, lessons 16 and 21. The author assessed the instructors in terms of their responses to student mistakes such as early, late, and incorrect responding. Criterion for proceeding to the next component of the training was 100% accuracy on correcting the aforementioned learners' mistakes by using the model-lead-test correction procedure and correct implementation of other Direct Instruction methodology. The third component of training was identical to the second; except the instructors role played among themselves, using the first two lessons of the food group format. In this arrangement, each instructor presented the material to the other two instructors as well as to the author (i.e., all three rotated, serving as the instructor as well as the learner). This more closely approximated conditions
Table 1

Sample of protocol used to record subject responses on the pretest, probes, and posttest.

<table>
<thead>
<tr>
<th>PRETEST/POSTTEST PROTOCOL: FOOD GROUP RESEARCH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables (Broccoli)</td>
<td>Vegetable (Celery)*</td>
</tr>
<tr>
<td>Dairy Product (Cottage Cheese)</td>
<td>Grains (Grain)</td>
</tr>
<tr>
<td>Fruit (Cherry)*</td>
<td>Vegetable (Carrot)</td>
</tr>
<tr>
<td>Meat (Ham)</td>
<td>Meat (Turkey)*</td>
</tr>
<tr>
<td>Fruit (Grape)</td>
<td></td>
</tr>
<tr>
<td>Meat (Tuna)</td>
<td>Meat (Pork)*</td>
</tr>
<tr>
<td>Dairy Product (Milk)</td>
<td>Grain (Oatmeal)</td>
</tr>
<tr>
<td>Fruit (Grapefruit)</td>
<td>Vegetable (Corn)</td>
</tr>
<tr>
<td>Vegetable (Pecano)</td>
<td>Dairy Product (Yogurt)</td>
</tr>
<tr>
<td>Fruit (Apple)</td>
<td></td>
</tr>
<tr>
<td>Meat (Bacon)*</td>
<td>Meat (Chicken)</td>
</tr>
<tr>
<td>Fruit (Orange)</td>
<td>Fruit (Lemon)</td>
</tr>
<tr>
<td>Vegetable (Onion)</td>
<td>Meat (Beef)</td>
</tr>
<tr>
<td>Meat (Egg)</td>
<td>Vegetable (Sprouts)</td>
</tr>
<tr>
<td>Vegetable (Beans)*</td>
<td></td>
</tr>
<tr>
<td>Fruit (Banana)</td>
<td>Dairy Product (Cheese)</td>
</tr>
<tr>
<td>Meat (Bologna)</td>
<td>Fruit (Peach)</td>
</tr>
<tr>
<td>Vegetable (Tomato)</td>
<td>Grain (Millet)</td>
</tr>
<tr>
<td>Dairy Product (Ice Cream)</td>
<td>Meat (Fish)</td>
</tr>
<tr>
<td>Vegetable (Lettuce)*</td>
<td></td>
</tr>
<tr>
<td>Vegetables (Peas)</td>
<td>Meat (Hot Dog)</td>
</tr>
<tr>
<td>Grains (Wheat)</td>
<td>Vegetables (Green B.)*</td>
</tr>
<tr>
<td>Vegetable (Spinach)*</td>
<td>Dairy Prod. (Butter)</td>
</tr>
<tr>
<td>Meat (Hamburger)*</td>
<td>Fruit (Blueberries)*</td>
</tr>
<tr>
<td>Fruit (Pear)</td>
<td></td>
</tr>
</tbody>
</table>

* Represents items which the subjects were not instructed.
In the study which required that the instructor present to a small group. The training lasted two weeks.

Instructors were not paid for their participation in the research, but received lab credit for their services. The instructor earned points for appropriate behavior and lost them for inappropriate behavior. Behaviors included both professional and academic skills. The instructors' point total directly related to their course grades.

The following measures were taken to ensure that the instructors adhered to the scripted format and generally followed the Direct Instruction methodology during treatment. An independent observer observed the lessons of each instructor three times a week for ten minutes each observation. If the instructor made minor mistakes such as omitting one second pause before dropping the hand in a hand signal, the observer would inform the instructor after the lesson on the deficit component. However, if the instructor made a major mistake such as omitting words from the scripted format, the observer would stop the lesson and correct the mistake before continuing instruction.

Dependent Variable

The researcher assessed the effects of instruction by administering a pretest and posttest that were identical in terms of construction, administration, and scoring techniques. The dependent variable was accuracy of categorizing (i.e., naming) foods as being a member of one of the five basic food groups mentioned previously. Each test contained 45 picture stimuli that were identical to the
picture stimuli used for the instruction. Embedded within the test were the following food items: ten fruit, six dairy products, thirteen vegetables, twelve meats, and four grains. The test contained no non-foods (see Table 1).

In addition to administering a pretest and posttest, three assessments of the subjects' food labeling responses were obtained within the instructional phase of the research. These probes were a portion of the pretest/posttest as the researcher selected two out of the five page test to measure the subjects' responses. That is, the researcher used pages one and two for the first assessment, three and four for the second assessment, and one and five for the third and final assessment. As with the pretest and posttest, none of the subject responses were reinforced for correct responding. Recording of subject responses for the probes consisted of simply using the corresponding sections of the pretest and posttest protocols.

Independent Variable

**Instructional Procedures**

All three instructional treatments shared characteristics that will be discussed at this time.

Teachers instructed the subjects on either a 1:3 or 1:2 ratio. The instructor sat facing the subjects and within arms reach with the lesson book supported on their knee or an adjacent table.

With the aid of the scripted format, the instructor presented verbal instructions coupled with one of two signals which prompted unison responding in the subjects. When the instructor exclusively
presented verbal stimuli, a hand drop signal cued responding. For example, if the instructor said, "Everybody, stand up," the instructor would give a one second "thinking pause" to allow the subject to prepare to respond. Then the instructor would slightly raise the already exposed palm and vigorously drop it to the hip area. At this time, the subjects responded. When pictures coincided with verbal instruction, the instructor used a point touch signal. This was similar to the hand-drop signal except the instructor pointed to the picture stimuli and touched the object to signal unison responding.

In order to ensure a fast rate of presentation, the subjects were corrected if they responded either too soon or too late after the signal which cued responding. Incorrect responses were dealt with by using the model-lead-test correction procedure (Carnine, 1977). Thus, contingent upon an incorrect response, the instructor would model the correct response, lead the entire group of students through the correct response (say it with them), and repeat the question again (test). This would be repeated until all subjects responded correctly.

The instructor reinforced the correct responses using both social praise and stickers. The subjects received praise for remaining on task or correct responding. Instructors praised behaviors ranging from correct responding on difficult items to remaining in their seat and attending to appropriate stimuli. Praise statements were both general and specific to the task. The subjects received stickers to supplement and increase the effectiveness of the verbal praise. Subjects earned up to three gum backed stars across each
lesson of instruction for appropriate social and academic behavior. The subject placed the star on a card made of construction paper for recording purposes. Upon receiving five stars, the subject received a food sticker. These stickers had pictures of fruit or vegetables on and when scratched, gave the aroma of the given food item. The instructor administered the starred stickers during the lesson, but did not administer the food stickers until the conclusion of the lesson. The instructor delivered stickers contingent upon correct responses across all experimental groups, but only during the instructional phase of the study and not during any of the testing periods, including the within instruction probes.

Each instructional approach (Generative I, Generative II, and Generative III) had its own respective formats. For all three instruction approaches, the researcher attempted to include examples which represented the widest range of members within each food group. The program included food items which varied in shape, size, and color to attempt to demonstrate the range of examples for each of the three approaches. Table 2 shows the range of examples sampled in the vegetable group. Subsequent food groups were taught in a similar manner. Each group received cumulative review for previously taught members.

Negative examples for the first group, vegetables, were selected from previously taught examples of non-foods. Negative examples for subsequent food groups were selected from previously taught food groups.

Also consistent across all three instructional approaches was the final component of instruction - food item classification. After
<table>
<thead>
<tr>
<th>Lesson:</th>
<th>Generative I</th>
<th>Generative II</th>
<th>Generative III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>X X R R R R R R R R R R X X R R R R R R X X R R R R R R X R R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>X X R R R R R R R R R R R X X R R R R R R X X R R R R R R X R R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td>X X R R R R R R R R R R R X X R R R R R R X X R R R R R R X R R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td>X X R R R R R R R R R</td>
<td>X X R R R R R R X X R R R R R R X R R</td>
<td></td>
</tr>
<tr>
<td>Onion</td>
<td>X X R R R R</td>
<td>X X</td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td>X X R R R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrot</td>
<td>X X R R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprout</td>
<td>X X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X - represents lessons in the format initially taught for each item.
R - represents cumulative review for each item.
the learners' mastered (responded 100% correct on all questions
during instruction) labeling the class name for items in the first
food class (e.g., vegetable), and began learning members of the next
class (e.g., fruit), a new form of label teaching began. During
this component of instruction, the program introduced a previously
taught food group member, but presented it's proper name as well
as it's relationship to a basic food group. For example, if initial
instruction had been for the vegetable food group and now instruction
began on the fruit group, the program included a format to teach the
specific names of all the previously taught vegetables, listed in
Table 2.

The duration of instruction was twenty to thirty minutes per day,
five days per week, for ten weeks. In the event that an individual
subject was absent, the instructor provided extra practice for the
returning subject on the current lesson, but not necessarily the
lesson the subject missed. If more than one subject from the same
group missed a lesson, the instructor repeated that lesson to the
entire group upon their return. The instructor recorded subject
attendance, date the instructor presented the lesson, and general
comments regarding subject responding.

The three instructional strategies, Generative I, GenerativeII,
and Generative III, differed in specific ways.

First, the Generative I approach began instruction in each food
class with the introduction of two food items as positive examples,
for two lessons. For example, instructors taught "tomato" and "corn"
as vegetables for two consecutive lessons. Instruction proceeded by
introducing "broccoli" in the fifth and sixth lessons, "onion" for the
introducing "broccoli" in the fifth and sixth lessons, "onion" for the seventh and eighth lessons, and so forth. The subjects in the Generative I approach, thus, had had prior exposure to every item in the later used food items naming format as a result of the food group labeling format.

The purpose of the Generative III group was to see if this format would be able to teach the new members within the review format, even though they had not been taught in the initial teaching sequences. This would save instructional time if it worked. Thus, in the Generative III approach, all examples for each food group were introduced simultaneously. Instructors presented various pictures of items in each food class as examples of the given food class, for three consecutive lessons. For example, in the vegetable food class the format introduced all the following food items on three consecutive lessons: "tomato," "corn," "peas," and "broccoli." After three consecutive lessons within the food class, instruction stopped for that food group and began for the next food class. During instruction in the second food class (fruit), additional instruction began on teaching the specific food name for members of the previously taught food classes (vegetable). Although the format for labeling foods presented the learners with no more than five foods for any given class, the food naming format included all of the foods taught in the Linear Additive approach (which totaled up to eight members). Thus, in addition to the previously mentioned vegetables in the Generative III group, the format presented the learners with three
vegetables in the food naming format embedded within the fruit food group labeling format (i.e., the instructor said, "This vegetable is an onion," even though onion had not been an example in the previous food groups instructional sessions). This is a generative aspect of the instructions the research hypothesized that the learner would generalize from the Initial set of examples to other members within the set.

The last approach was a Generative II method (aspects of both the Generative I and Generative III). The program designers developed this term because the format for teaching items using this strategy was identical to the Generative approach with one exception; instead of introducing all of the food items, it introduced only a subset of these members. As with the Generative I approach, instruction began on each food class with two food items for two lessons. The remaining three items were introduced one at a time and for two days each. Additionally, however, this method also included the use of a labeling items format in the lessons on the next food group (fruit), teaching format for each food group took eight days as compared to three in the Generative III approach, and fourteen in the Generative I approach. The Generative II approach and the Generative I approach were identical except in the number of food items presented from each food group.

Reliability

Reliability during the testing period focused on the recording of the subjects' responses to the test items. An independent obser-
ver made reliability checks on 15 of the 18 pretests and 18 of the 18 posttests. Both the instructor and the independent observer had identical test protocols, recording the responses of the subjects during the complete duration of the test. The researcher calculated reliability by dividing the item agreement of the observers by the agreements plus disagreements, and multiplying the quotient by 100. Reliability measures yielded 92% agreement on the pretest and 98% agreement on the posttest scores. No reliability data were collected on the probes.

The study terminated after ten weeks of instruction and one week of posttest assessment. This coincided with termination of the academic semester for the college student instructors.
CHAPTER III

RESULTS

Figure 1 shows test results on all three experimental groups and control group. Data points represent the mean percent correct on pretest, probes 1, 2, and 3, and posttest. To calculate each data point, the researcher divided the sum of correct responses for a group on a given test by the total number of items presented to that group on that test (i.e., 45 items on pretest and posttest; 18 items on all three probes).

The mean percent correct of the control group was stable across all tests, fluctuating no more than ±2% from a mean of 2%. The control group scored 1.7% lower on the posttest than the pretest.

All experimental groups showed increases in mean percent correct responding from pretest to posttest. The Generative III group increased 81% from the pretest score with increases across the within instruction probes. The Genrative I group increased across the within instruction probes 71% over pretest score. The Generative II group showed a 41.4% increase from pretest to posttest. However, this increase occurred totally in the first probe, and the performance dropped off on the subsequent probes.

Table 3 shows percent correct responses and raw scores on the pretest and posttest for each subject. The table shows that individual subject scores generally represent the group means in Figure 1.

The two highest scores on the pretest were Subject 2 of the
Figure 1. Shows mean percent correct for all food groups across pretest, within instruction probes, and posttest for three experimental and control groups.
### Table 3

Percent Correct and Raw Scores on Pretest and Posttest for Individual Subjects in the Experimental Groups. Maximum possible score = 45

<table>
<thead>
<tr>
<th>Test Scores</th>
<th>Generative I</th>
<th></th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pretest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subject 1</td>
<td>0% (0)</td>
<td></td>
<td>67% (30)</td>
</tr>
<tr>
<td>Subject 2</td>
<td>0% (0)</td>
<td></td>
<td>44% (20)</td>
</tr>
<tr>
<td>Subject 3</td>
<td>0% (0)</td>
<td></td>
<td>82% (37)</td>
</tr>
<tr>
<td>Subject 4</td>
<td>0% (0)</td>
<td></td>
<td>67% (30)</td>
</tr>
</tbody>
</table>

| Generative II |  |                      |          |
|---------------|-----------------------|----------|
| Subject 1     | 20% (9)               | 47% (21) |
| Subject 2     | 0% (0)                | 44% (20) |
| Subject 3     | 2% (1)                | 42% (19) |
| Subject 4     | 0% (0)                | 69% (31) |

| Generative III |  |                      |          |
|----------------|-----------------------|----------|
| Subject 1      | 13% (6)               | 89% (4)  |
| Subject 2      | 26% (12)              | 75% (34) |
| Subject 3      | 4% (2)                | 78% (35) |
| Subject 4      | 0% (0)                | 64% (29) |
| Subject 5      | 4% (2)                | 96% (43) |
Generative III group and Subject 1 of the Generative II group. Their scores were 26 (12 raw score) and 20 (9 raw score) percent respectively. Subject 2 responded "vegetable" to all items on the pretest and Subject 1 responded "meat" to approximately 80% of the items on the pretest. On the posttest, subject scores within each group were evenly distributed around the mean for the groups with two exceptions. Subject 4 in the Generative II group scored 22% (10 more correct) higher than the next highest score in that group (Subject 1), and Subject 2 in the Generative I group scored 23% lower than the next lowest score for that group (10 less correct).

Figure 2 shows group mean percent correct responding across each food group as a function of the lessons taught and the instructional approach. Dashed lines represent initiation of the instruction for the food group and the termination of instruction for the previous food group. However, each approach used cumulative review for previously taught food groups (i.e., previous taught food groups were reviewed in subsequent lessons).

The data generally show that when all three experimental groups completed instruction for a food group, the group mean score was above 75% for that food group on subsequent probes. The experimental group mean score on probes for food which had not been taught was below 37.5%. This pattern of results was obtained for 39 of the 45 data points.

Six exceptions occurred: (1) the fruit score [50%] in the first probe for the Generative III group, (2) the grain score [73%] in the
third probe for the Generative III group, (3) the meat score [50%] in the third probe for the Generative I group, (4) the meat score [62%] in the first probe for the Generative II group, (5) the grain score [48%] in the third probe for the Generative I group, (6) the grain score [77%] for the Generative II group.

Table 4 shows each group's mean percent correct responses on pretest and posttest for items in the vegetable, meat, and fruit groups that were taught and not taught during the instructional phase of the research. Pretest scores on all items across experimental groups were below 18% with one exception (Subject 2, Generative III group, who responded "vegetable" to all pretest items). Posttest scores on the listed taught items were above 71% with two exceptions: meat (56%) and fruit (21%) scores in the Generative II group. Posttest scores across the experimental groups for the items not taught in instruction were above 65% with two exceptions: fruit scores in the Generative I (63%) and Generative II (25%).
Figure 2. Mean percent correct for each food group on pretest, three probes, and posttest as a function of lessons taught for each of the three experimental groups. Dashed lines and the letters associated with them indicate in introduction of instruction for a given food group (i.e. V = vegetable; M = meat; F = fruit; DP = dairy product; G = grains).
Table 4

Percent correct on pretest and posttest within experimental groups for both items taught and not taught during the instructional phase of the research (total of 35 items).

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th></th>
<th></th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Taught</td>
<td>Not Taught</td>
<td>Taught</td>
<td>Not Taught</td>
</tr>
<tr>
<td><strong>Generative I:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetable</td>
<td>0%</td>
<td>0%</td>
<td>88%</td>
<td>65%</td>
</tr>
<tr>
<td>Meat</td>
<td>0%</td>
<td>0%</td>
<td>88%</td>
<td>68%</td>
</tr>
<tr>
<td>Fruit</td>
<td>0%</td>
<td>&lt;4-1</td>
<td>95%</td>
<td>80%</td>
</tr>
<tr>
<td><strong>Generative II:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetable</td>
<td>0%</td>
<td>0%</td>
<td>71%</td>
<td>80%</td>
</tr>
<tr>
<td>Meat</td>
<td>16%</td>
<td>18%</td>
<td>56%</td>
<td>81%</td>
</tr>
<tr>
<td>Fruit</td>
<td>0%</td>
<td>0%</td>
<td>21%</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Generative III:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetable</td>
<td>25%</td>
<td>24%</td>
<td>88%</td>
<td>68%</td>
</tr>
<tr>
<td>Meat</td>
<td>8%</td>
<td>10%</td>
<td>78%</td>
<td>85%</td>
</tr>
<tr>
<td>Fruit</td>
<td>0%</td>
<td>0%</td>
<td>95%</td>
<td>80%</td>
</tr>
</tbody>
</table>

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a - eight items on pretest and posttest for each subject  
b - five items on pretest and posttest for each subject  
c - eight items on pretest and posttest for each subject  
d - four items on pretest and posttest for each subject  
e - eight items on pretest and posttest for each subject  
f - two items on pretest and posttest for each subject
CHAPTER IV

DISCUSSION

In all three experimental groups, the mean percent correct responding increased at least 41% on posttest scores over the pretest scores. The Generative III group made the highest gain over pretest, but was the only group to complete instruction across all food groups. Thus, based on assessment of group responses across individual food groups as a result of instruction on that food group, all three strategies appear to be effective in teaching food groups to preschoolers. However, the apparent distinguishing factor of the effectiveness in the Generative III approach can not be discounted. Completion of the food group formats for the other two groups, Generative I and Generative II, would take over twice the time as the Generative III approach. Perhaps, when teaching noun concepts which share few critical visual feature differences, the time saving feature is the only noteworthy characteristic in the Generative III approach (albeit, a powerful characteristic).

This research indirectly supports previous finding such as Project Follow Through (Becker and Carnine, 1976) which empirically noted the power of a Direct Instruction approach with naive learners. Moreover, the relative effectiveness of all three strategies in the present study supports research which demonstrates the effectiveness of other Direct Instruction components. Held constant across all three experimental groups were the use of hand signals (Carnine and Fink,
1976), fast rate of presentation (Massad and Etzel, 1972), systematic corrections (Carmin, 1976) and the sequencing of examples (Stolurow, 1975). The use of these techniques as well as other Direct Instruction components mentioned in the method section of the research, certainly contributed to the overall gains in scores over pretest.

However, some abnormalities in the data bear further explanation to further qualify the effectiveness of the research. Subject 1 in the Generative I treatment showed posttest scores which were significantly different from either the group mean or from other subjects in the group (Table 3). Typically, subject selection for small groups in direct instruction is made by forming homogeneous groups in terms of skill level, based on academic screening. For research purposes, subjects were randomly assigned to the experimental groups, and this may explain these isolated instances of variability from the mean.

The "exceptions" mentioned in the results section, relative to Figure 2, are also noteworthy to mention. The first three anomalies (fruit scores in Probe 1, Generative III; grain scores in Probe 3, Generative III; meat scores in Probe 3, Generative I) show a trend of acceleration. Moreover, the scores subsequently increase to above 74% and stabilize throughout the remaining probes and the posttest.

In the fourth abnormal data point, the meat score in Probe 1 (Generative II), the score was higher than the trend of the other data. Typically, subjects' received the probe assessment prior to instruction. In the case of this probe, the subjects' were tested after the first day of instruction in the meat food group (notice the
Generative I data point on meat in the first probe in which they received the test prior to instruction). The fifth and sixth data points include high scores in the grain food group on the third probe for the Generative I and Generative II groups. The probes contained only two grain items and the nature (i.e. appearance) of their shape made them very different from the other items. Further, the nature of administering the test (multiple choice) allowed for "guessing" at items as the tester initiated testing by saying "...you are going to tell me what food group; either vegetables, meats, fruits, dairy products, or grains."

In Table 4, which shows correct responding on taught and un-taught items, there appears to be no strong pattern in the data. However, the procedure with the highest mean percent correct across the three food groups is the Generative III approach. Generally, the data in Table 4, as well as other data presented, appear to show a relationship between instruction on the food group(s) and correct responding to test items taught and not taught (i.e., a tendency to correctly generalize to novel members within the set).

Future research in this area would appear to be beneficial to the field of Direct Instruction. Some possible areas to expand on this study would include the incorporation of more within instruction probes to detect discrete changes in subject responding. A longer duration of a study in this area might show different levels of group responding - especially in the Generative I and Generative II procedures. A final suggestion would be to incorporate an alternative teaching approach, other than a Direct Instruction strategy, to make
comparisons analogous to Project Follow Through. Carnine (1976) in a study investigating the effect of a generative approach to a concept on a continuum stated that his finding "can be applied to teaching any essential characteristics which are defined by a range of values" (Carnine, 1976, p. 142). Perhaps this study lends itself to a similar statement on noun concepts which have few common features.

The effects of the Generative III approach in this study warrants both future research in this area and the incorporation of applied instruction in the area of food group labeling or other noun classes.

Direct Instruction has been shown to be effective in the area of mathematics, language, spelling, and reading. This study demonstrated how this form of instruction can be utilized in the area of nutrition instruction, and perhaps generally for area of instruction other than the teaching of basic academic skills.
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