JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1981, 14, 465-478 NUMBER 4 (WINTER 1981)

# A FUNCTIONAL ANALYSIS OF PHOTO-OBJECT MATCHING SKILLS OF SEVERELY RETARDED ADOLESCENTS

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Matching-to-sample procedures were used to assess picture representation skills of severely retarded, nonverbal adolescents. Identity matching within the classes of objects and life-size, full-color photos of the objects was first used to assess visual discrimination, a necessary condition for picture representation. Picture representation was then assessed through photo-object matching tasks. Five students demonstrated visual discrimination (identity matching) within the two classes of photos and the objects. Only one student demonstrated photo-object matching. The results of the four students who failed to demonstrate photo-object matching suggested that physical properties of photos (flat, rectangular) and depth dimensions of objects may exert more control over matching than the similarities of the objects and images within the photos. An analysis of figure-ground variables was conducted to provide an empirical basis for program development in the use of pictures. In one series of tests, rectangular shape and background were removed by cutting out the figures in the photos. The edge shape of the photo and the edge shape of the image were then identical. The results suggest that photo-object matching may be facilitated by using cut-out figures rather than the complete rectangular photo.

DESCRIPTORS: photo-object matching, stimulus control, discrimination, classification, retarded adolescents

Pictures are among the most commonly used materials in both education and human research. Pictures are often more convenient and economical to present and store than real objects. Given the physical limitations of classrooms and training or therapy areas, it is often impossible to present real objects, e.g., mountains and farm animals. The use of pictures for research and educational purposes is often based upon the assumption that pictures are representative of the environment, particularly when high-fidelity photos are used. For normal persons and for persons classed at the educable and trainable levels of retardation, the assumption is probably valid.

It is becoming increasingly common to find pictures being used as the communication medium in lieu of spoken, printed, or manual sign communication with severely retarded persons (e.g., Murphy, Steele, Gilligan, Yeow, & Spare, 1977; Spellman, DeBriere, Jarboe, Campbell, & Harris, 1978; and Vanderheiden, 1976). Because of the arbitrary relation between spoken words or manual signs and the environmental referents, establishing symbolic communication is often long and arduous. In using pictures as the medium for communication, the person is typically trained to give a motor response (such as pointing) to a picture as a request for the object or activity represented. The justification for attempting to establish picture communication skills with severely and profoundly retarded persons is quite appealing. Picture communication is usually considered as a training objective when other systematic and intensive training

This research was supported by NICHHD grants HD00870, HD11194, and HD02528 to the Kansas Center for Research in Mental Retardation and Human Development. The author expresses appreciation to Joseph E. Spradlin and Michael H. Dixon for their suggestions and support throughout the study, to Jacqueline Moss for conducting the experimental sessions, and to Pamela Cress for her helpful comments on the manuscript. Reprints may be obtained from Lois S. Dixon, Psychology Department, Kansas Neurological Institute, 3107 West 21st St., Topeka, Kansas 66604.

programs have failed to establish either spoken language or manual signing skills. Spoken or printed words and manual signs represent an object only through conventional use. As each new object is introduced, a new arbitrary association between a symbol and the referent stimulus must be established. In contrast, pictures, particularly high quality drawings and photos, have the advantage of physical similarities between the object pictured and the object itself. The relationship between a photo and the object pictured is not an arbitrary relation. Thus, new objects may be introduced without having to establish specific relations to the corresponding photographs of the objects.

A more common use of pictures in training retarded persons is the substitution of a picture for an object in establishing traditional symbolic or language skills. A critical element in using pictures as substitutes for objects or as substitutes for symbols is whether or not the pictures actually represent the environment for the student being trained. In training programs, the substitution of photos for objects is commonly based upon the implicit assumption that the substitution is functional for the student. Currently, there are some data available that suggest that such an assumption is valid.

With normal children, picture representation skills appear to emerge early in development. By approximately 15 mo of age, a normal infant typically demonstrates verbal labeling of both pictures and objects. A transfer of learning study by Daehler, Perlmutter, and Meyers (1976) has formally demonstrated equivalence of photos and objects for children as young as 24 mo. Based on a great deal of research in perceptual development, Gibson (1969) has suggested that picture representation of objects requires little or no learning beyond the perception of objects themselves. Such suggestions from normal development would seem to encourage the use of pictures for training severely retarded persons. That is, if picture representation skills are typically demonstrated early in the development of a normal child, and other evidence suggests that little learning beyond perception of objects is required, then it appears reasonable to speculate that pictures may also function to represent the environment for severely delayed persons. However, the severely retarded in classroom settings (schools or institutions) have a long history of interacting with an environment that is different from that of a young normal child. It is, therefore, erroneous to assume that skills demonstrated by very young, normal children will be found in the repertoires of older, severely retarded persons.

Several studies compared relative rates of learning with pictures and objects. Research with mentally retarded children (Welch & Pear, 1980) and normal children as young as 24 mo (Daehler, Perlmutter, & Meyers, 1976) suggests equivalent rates of acquisition with pictures or objects. However, other studies, suggesting that acquisition is more rapid with objects, have included a variety of tasks with human infants (Fantz, 1966), mentally retarded children (House & Zeaman, 1960; Iscoe & Semler, 1964), young normal children (Stevenson & McBee, 1958) and monkeys (Harlow, 1945). Overall, these studies suggest that any difference in rate of acquisition would favor selection of objects over pictures for use in training programs.

Other researchers have examined transfer of learning with pictures to the objects pictured. With normal children ranging from 24 mo to 45 mo of age, Daehler, Perlmutter, and Meyers (1976) demonstrated transfer of learning from photos to objects and from objects to photos. This assessment of transfer of learning was conducted under the same conditions as training. Although the photos and objects appeared to function as equivalent for normal children, training conducted with retarded children requires transfer of learning with pictures to objects located in environments other than the training setting. Guess, Sailor, and Baer (1978) have strongly discouraged persons from using pictures rather than objects in establishing language skills for severely retarded persons. The

use of photos in a training environment reduces the similarity between the conditions of training and other environments where demonstration of the new behavior is desired. Recently, Welch and Pear (1980) compared training with drawings, photographs, and real objects to determine the effect of the stimulus modality on generalization or transfer of a naming response to real objects in the natural environment. Four mentally retarded children participated. Three of the four children demonstrated higher accuracy of naming the objects in the natural environment when the same objects were also presented in training. These results support the earlier recommendation (Guess et al., 1978) to use real objects in training situations.

The issues of relative rates of acquisition and transfers of learning with pictures and objects are very important issues when the pictures do indeed represent the environment for the students. The general purpose of the current research was to examine systematically a number of other issues related to the picture representation skills of nonverbal, severely retarded adolescents and to identify variables which may potentially facilitate establishing picture representation skills which will be discussed with the methods of assessment below.

## EXPERIMENT 1

### METHODS

#### *Participants*

Seven severely retarded adolescents were selected from a group of 16 students participating in a special clinical project at the Parsons State Hospital and Training Center to participate in the study. At the start of the current study, the ages of the retarded students ranged from 13 yr, 3 mo to 19 yr, 3 mo. The median age was 15 yr, 7 mo. The length of institutionalization ranged from 4 to 14 yr.

All participants were ambulatory, self-feeding with a spoon, and untestable on any standardized IQ test. SQ scores on the Vineland Scale of Social Maturity ranged from 12 (S5) to 34 (S4) with a mean of 25. Students 1, 2, and 3 were toilet trained. S2 and S3 demonstrated some limited receptive language skills and a few verbal utterances. S1, S4, and S6 reliably responded to their names when called, but failed to demonstrate any other receptive or expressive language skills. At the time the study was initiated, none of the students had been given a subjective visual acuity assessment. Three students, S3, S6, and S7, did have strabismus. However, the extent of visual impairment was unknown. S6 was given an objective visual assessment and glasses were prescribed during the experiment. The remaining students were assumed to have normal vision, which was confirmed by a subjective assessment after the study terminated.

#### *Pretraining History*

Matching-to-sample procedures have broad application to a variety of assessments and training programs. The objective of the pretraining was to teach the students to match to sample so that matching-to-sample procedures could subsequently be used to assess and, if necessary, train discrimination classification and representation skills (Dixon, Note 1). Without a demonstration that a student can perform a task with some stimuli, a failure on any specific pretest may be due to task variables, reinforcer or motivational variables, or stimulus content variables. Pretraining on the assessment task reduces the probability that a failure on a specfic pretest assessment was due to task variables. If the contingencies on the assessment are the same as those used to establish the task performance, then failure due to motivational variables is similarly reduced. Other variables such as fatigue, may also affect performance on any given assessment. Pretraining can reduce the probability of failure due to task and motivational variables under the assessment conditions and thus enhance the probability that a skill will be demonstrated without long periods of training.

The students participating in the current study completed the pretraining sequence within approximately six mo to 1 yr. During pretrain-

ing, two variations of matching-to-sample procedures were established. Both matching procedures were used in the current study and will be described below. Stimulus conditions in pretraining included matching both identical objects and nonidentical objects of the same class. Nonidentity matching included matching similar objects such as different cups and matching forks to spoons.

In addition, a token exchange system was established for each student. Consequences for each correct or incorrect response were delivered until identity and nonidentity matching were well established. Consequences were later given intermittently on one-third of the trials which were preselected before each session. The purpose of maintaining the established skills on intermittent consequences was to permit the substitution of assessment or test trials where no consequences were scheduled for delivery. This procedure is particularly useful on assessments of preferences of choice selection and/or analysis of stimulus control where reinforcement on the test trials may alter the results.

*Procedures*

*General procedures.* The stimuli for each test in Experiment 1 were presented within the same paradigm. Two boxes, 25.5 × 25.5 × 7 cm, were placed horizontally in the center of the table approximately 15 cm apart. The edge of each box was approximately 20 cm from the table edge of the student's side. For each trial, the experimenter placed a choice stimulus in the center of each box. The student was required to place the hands back from the table, preferably in the lap, before the experimenter placed the sample object on the table in front of the student. The sample stimulus was placed directly in front of the student approximately 7 cm from the table edge. No verbal instructions were given. The sample was placed on the table with a slight audible sound. The sound of the sample being placed on the table was used as a stimulus to attract the student's attention to the sample. Whenever the student failed to respond immediately, the experimenter tapped the sample with a pencil. The student was to pick up the sample, place it in one of the two boxes, and release the sample. If the student placed the sample in the box containing the correct choice stimulus, the experimenter rang a doorbell, delivered social praise (e.g., smiles, pats, "good"), and a token. Tokens were exchanged for small edibles or liquids whenever the student accumulated five tokens, or they were exchanged for larger items at the end of the session. If an incorrect response occurred, the experimenter removed the stimuli, recorded the response, and progressed to the next trial. Throughout each assessment, the stimuli were presented as samples in a mixed order with equal frequency. The choice stimuli were presented equally in the left and right positions.

The students were seen once per day, five days per week. Each individual test consisted of 20 trials, and only one test was presented in a session. Sample trials from each test are presented in Figure 1.

*Discrimination assessment.* The initial assessments presented were identity matching to sample of the objects and the photos selected for the analysis of picture representation. Identity matching-to-sample procedures were used to assess the visual discrimination. Two issues are important with these assessments. First, visual discrimination of the stimuli is a necessary prerequisite for demonstrating picture representation. If a student fails to demonstrate visual discrimination between or among the stimuli, there is no point in assessing photo-object matching. Second, Gibson (1969) suggested that picture representation may require little or no learning beyond the perception of objects. Given students who demonstrate identity matching of the objects and the photos, we may then ask if this is a sufficient condition for the demonstration of picture-object matching.

Identity matching to sample of the two objects, a cylinder and a banana, was presented in the first session. The criterion for terminating the object matching-to-sample was 100% correct responding for one session or 90% correct

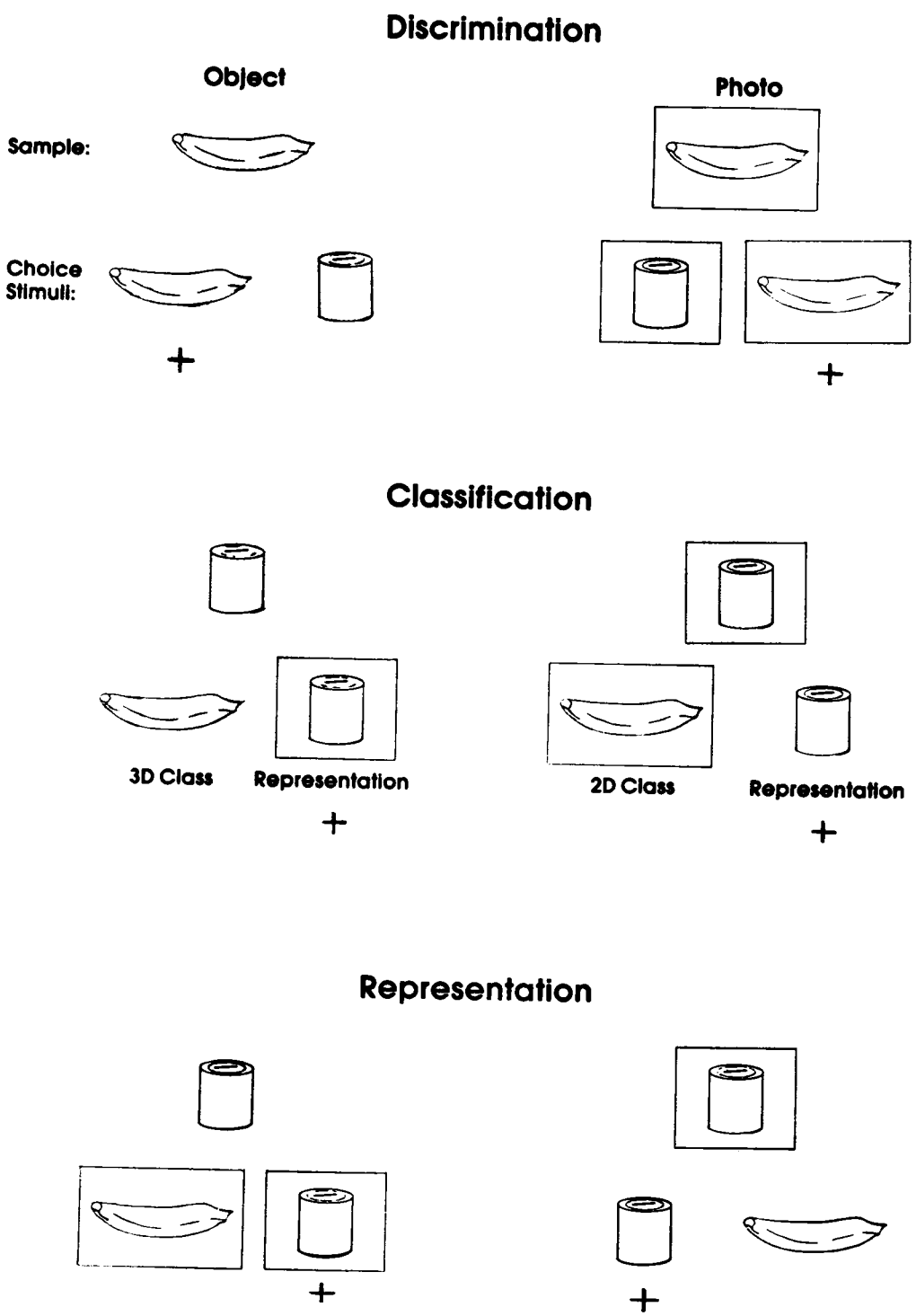


Fig. 1. Illustration of the types of stimulus arrays presented in each assessment. Plus marks (+) indicate the availability of reinforcement for choice stimulus selection.

responding for two consecutive sessions. Photographs were substituted for the objects in the following session of identity matching to sample using the same criterion as object matching. Students who failed to meet the criterion were discontinued from the study.

*Representation versus 2D, 3D classification.* Although a photo may function to represent an object, a picture is also an entity or object itself with physical properties in common with other photos of different objects. In everyday life, we commonly group pictures together for storage purpose. For example, in conducting the current study, the experimenter stored the photos together in one area of her desk drawer and the objects in another area. Photo-object matching would seem to require the student to ignore the physical properties of the photo itself and to respond to the similarities between the image in the photo and the object. This assessment was designed to evaluate classification of a sample (photo or object) along some aspect of its dimensional class membership versus photo-object matching or representation.

Specifically, for each trial, one choice stimulus matched the sample on the basis of dimensional class membership of photos or objects, i.e., photo-to-different-photo or object-to-different-object. Figure 1 illustrates trials with a photo sample and with an object sample. The second choice matched across the two classes of an object to the photo of the object. Because photo-object matching was the skill of interest in the current study, reinforcement was made contingent upon the photo-object match. Responding to the different stimulus from the same dimensional class as the sample resulted in the experimenter removing the stimuli and presenting the next trial. The assessment was presented for one session.

*Representation assessment.* The final assessment was a direct test of photo-object matching. If the sample were a photograph, the choice stimuli were both objects. If an object were presented as the sample, then two photos were presented as choice stimuli. Correct matching of corresponding photos and objects was reinforced. When errors occurred, the experimenter removed the stimuli and presented the next trial. The assessment was presented for one session.

*Reliability Recording*

A second observer recorded the students' responses along with the experimenter for at least two test sessions for each student. The observer also recorded the experimenter's behavior to determine if the experimental procedures were being followed and to watch for any experimenter behavior which could potentially be influencing or biasing the students' responding. The observer recorded the stimuli as they were presented in the session rather than following the predetermined list of stimulus presentations. These records were compared to the predetermined list for one measure of reliability of experimenter behavior. Several sessions were scored from videotapes.

Reliability of recording the students' responses was 100% agreement. The agreement was based upon a comparison of trial-by-trial recording by the experimenter and observer. The observer's records of the experimenter's behavior indicated four errors during Experiment 1. Three errors consisted of skipping a trial in the predetermined sequence, which was noted by the experimenter and later added within the same session. One error was in reversing the left-right positioning of the choice stimuli.

## RESULTS

All the students scored 100% correct on the object discrimination test in the first session. S1, S2, and S3 also scored 100% correct on the first session assessing photo discrimination. S4 and S5 met criterion of 90% correct or better for two consecutive sessions in the 10th and 15th session, respectively. Across the sessions of presenting the photo matching task, these students generally scored between 70% and 85% correct. S6 and S7, both of whom had strabismus, scored around chance and showed no evidence of acqui-

sition. After 25 sessions, these students were discontinued.

Figure 2 shows the results of the five students who met criterion on the object and photo discrimination tests. On the representations vs. 2D, 3D classification assessment, S1 consistently selected the photo-object or representation match. The representation match was defined as the correct response on this task. S1's performance is shown as 100% correct in Figure 2. The remaining four students scored below chance on matching the corresponding photo-objects. S5 only made one photo-object match. The remaining students made three or four photo-object matching responses. The three or four photo-object matching responses by S2, S3, and S4 occurred intermittently across the 20 trials and included both object and photo samples. All the remaining 16 to 19 responses were matching one object to a dissimilar object and a photo to a dissimilar photo.

On the representation assessment, S1 again scored 100% correct on matching the photo-to-object and vice versa. The four students who matched photo to dissimilar photo and object to dissimilar object on the classification task all scored at or near chance on the representation assessment.

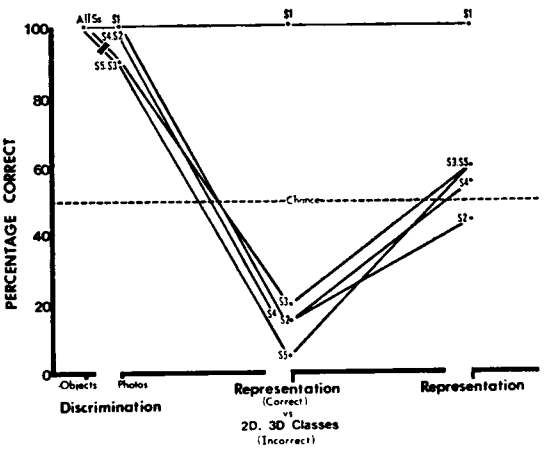


Fig. 2. Percentage of correct responses for each student across the three tests. The letter N and the dashed line represent the normal students. A break in the lines for S3 and S5 between the object discrimination and photo discrimination task indicates training on photo discrimination.

## DISCUSSION

All the students demonstrated visual discrimination between the objects, and five students demonstrated discrimination between the photos. However, S4 and S5 required several sessions before criterion was met, and the investigator failed to establish the discrimination for S6 and S7. Because all students had demonstrated generalized identity matching of objects during pretraining and again on the object discrimination test of the current study, poor visual acuity is one variable that could be responsible for the poor performance of identity matching of pictures. Glasses were prescribed for S6 during the study, but his performance on matching photos was not affected. The prescription was based upon an objective examination. Because he failed to demonstrate picture discrimination, no subjective examination could be given to assess the adequacy of the prescription.

The results of the representation vs. 2D, 3D classification showed differences in performance across students that correlated with the accuracy of photo-object matching on the representation assessment. S1 matched corresponding objects and photos rather than matching dissimilar members of 2D, 3D classes on the classification assessment. S1 also accurately matched photos and objects on the representation assessment. The remaining four students matched dissimilar members of the 2D, 3D classes on the conceptual assessment. Subsequently, these students performed at chance on matching corresponding objects and photos on the assessment of picture representation. As noted in the Results section, these four students did make a few responses of matching photos and objects on the conceptual assessment, and they received a reinforcer for each of the representational responses. The matching of dissimilar photos and dissimilar objects may be described as counter or opposite the reinforcing consequences which may suggest a strong preference or bias to matching on the

basis of the class dimensions or physical similarities within the 2D and 3D classes.

The results also indicate that even though severely retarded persons may demonstrate discrimination between objects and between photos of the objects, they may fail to demonstrate object-photo matching. This is particularly surprising in view of the fact that life-size, full-color photographs of high fidelity were used, and the students were well trained with the experimental procedures. Whereas picture representation may emerge in infancy with little or no specific learning beyond learning to perceive edges of 3D objects, the results of the current study indicate that the demonstration of visual discrimination of objects and photos is not sufficient for the demonstration of picture representation.

These results suggest extreme caution in using pictures in educational and language training programs for severely retarded persons. Pictures used in many educational programs contain neither the quality nor the simplicity of those professionally produced for the current study. Before pictures are introduced in training, it would be advisable to assess whether the pictures are indeed representative of the environment. Matching photo-to-object is one method for such assessment.

The results of the conceptual assessment suggest that the failure to demonstrate photo-object matching or picture representation might be attributed to stimulus control by the physical similarities between photos and between objects. Of all the possibilities of controlling variables the most obvious are the rectangular, straight-edge shape and flatness of the photos as opposed to the depth, height, and curved lines of the objects. In attempting to plan a program for establishing the photo-object matching skills, it would be helpful to have a better understanding of the controlling stimulus-response relations within the photo-object matching task. Experiment 2 was designed to analyze some of the controlling variables within the two classes of stimuli.

## EXPERIMENT 2

The students who failed to match objects to photos in Experiment 1 may have attended to the rectangular edge and flatness of the photos rather than the figures. Experiment 2 is an experimental analysis of some of the figure-ground variables in matching of photos and objects. In one series of tests, the rectangular ground was removed by cutting out the figure. In this case the edge of the photo itself and the edge of the image or figure within the picture are the same. In addition, the edge shape of the cut-out figure may have at least some physical similarity to the edge of the object pictured. This is particularly true of the banana used as a stimulus in Experiment 1. The cut-out figure retains the flat surface properties of a photo but may have some edge shape which is similar to the object. In Experiment 2, assessments were given to determine if the students would match the cut-outs to photographs or to objects. The increase in physical similarity of a cut-out figure to the objects could result in more accurate matching to objects.

In contrast to removing the rectangular ground from the photos, the photographic ground was added to the 3D objects in a second series of tests. In these assessments the objects were glued onto the life-size figure in the photos. Under these conditions the stimulus retains all the properties of a three-dimensional object and also has the added properties of photographic ground.

### METHOD

#### *Students and Experimental Setting*

The five retarded students from Experiment 1 also participated in Experiment 2. The setting was the same as in Experiment 1. The cylinder, banana, and corresponding photos were again used as stimuli.

#### *General Procedures*

The matching-to-sample procedures were altered from the conditions of Experiment 1. The

sample, cut-out photo of the banana or cylinder, was placed in a box centered on the table. Two choice stimuli were placed directly in front of the student. The student was to pick up one of the choice stimuli and place it in the box containing the sample.

The tests to be presented in Experiment 2 did not have a choice stimulus that was correct or necessarily a better response selection than the second choice stimulus. Therefore, the investigator chose to withhold consequences on the test trials. However, some reinforcement within the sessions was necessary to maintain responding. Identity matching trials of objects and photos were presented as trials where reinforcement was provided for correct responding on an intermittent basis. If all responses on identity matching trials resulted in reinforcement, a student might interpret the absence of reinforcement on a test trial as an indication that the response was incorrect.

*Identity Matching*

Prior to presenting the assessments, the students were again given trials of identity matching. Within each identity matching session, the students were given 12 trials of identity matching the objects cylinder versus banana and 12 trials of identity matching the photos of the cylinder versus banana. The trials were presented in a mixed sequence. Each stimulus appeared as the correct and incorrect choice stimulus with equal frequency across the two positions. In the first session, all correct responses were reinforced. Once a student scored 88% correct (21/24) or better in one session, the consequences were changed from continuous to intermittent. Of the 24 trials of each session, 6 were preselected for providing positive consequences for correct responses or corrective procedures for incorrect responses. On trials not scheduled for consequences, the experimenter removed the stimuli and progressed to the next trial. Once the student met an accuracy criterion of 88% correct or better for two consecutive sessions, he or she was given the first assessment.

*General Assessment Procedures and Testing Sequence*

The first two assessment tests were presented as unreinforced test trials among trials of identity matching objects and photos. Each session consisted of 8 test trials and 16 trials of identity matching. Six of the identity matching trials were preselected for providing consequences for correct or incorrect responding. After a response on a test trial, the experimenter removed the stimuli and progressed to the next trial. Each test was presented for two consecutive sessions. The sequence of trials was altered between sessions. Figure 3 presents the stimulus arrangements for each of the tests of Experiment 2 with the cut-out photo as the sample.

When the object glued to the photo was presented as the sample, the choice stimuli were the same as those shown in Figure 3. After presenting two sessions of one assessment with the cut-out figure as the sample, the next two sessions presented the same test with the object glued to the photo as the sample. The testing sequence was as follows: Test 1 with cut-out photo sample; Test 1 object glued to photo sample, Test 2 with cut-out photo sample; Test 2 object glued to photo sample; Test 3 cut-out photo sample; and Retest of the entire sequence. The results of the assessments with the objects glued to photos were inconsistent within student and with a subsequent replication of the tests. The remaining description of the tests and data presented is limited to the series of tests with the cut-out photo as the sample.

## ASSESSMENT TESTS AND RESULTS

*Test 1*

The students were given the cut-out figure as a sample with the matching object and matching photograph as the two choice stimuli. The purpose of this test was to determine if the students would systematically match the cut-out photo sample to the object match or photo match. The cut-out figure, particularly the banana, has some

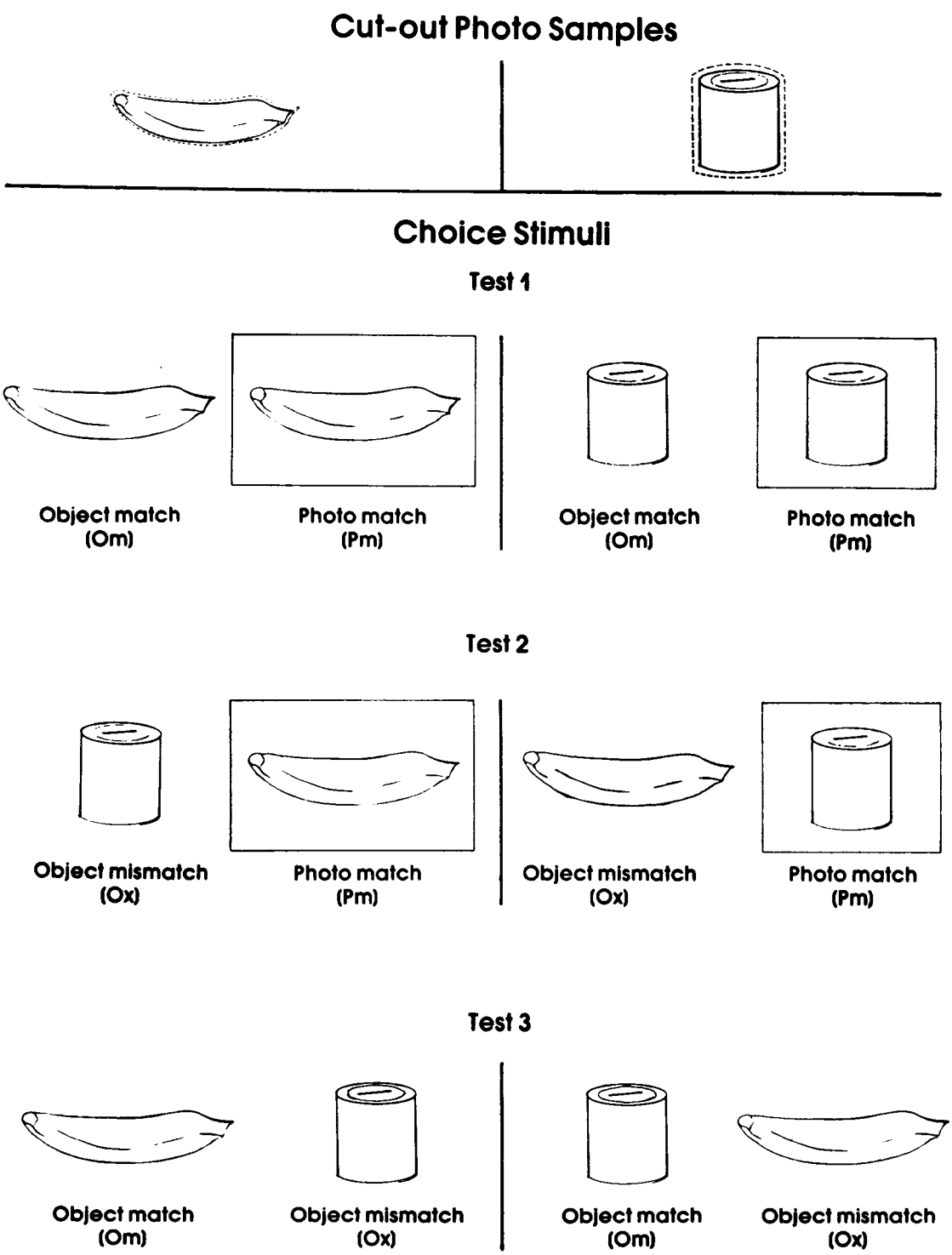


Fig. 3. Illustration of the types of trials presented with the cut-out photo sample. The choice stimuli were identical as illustrated when the sample was an object glued to a photograph.

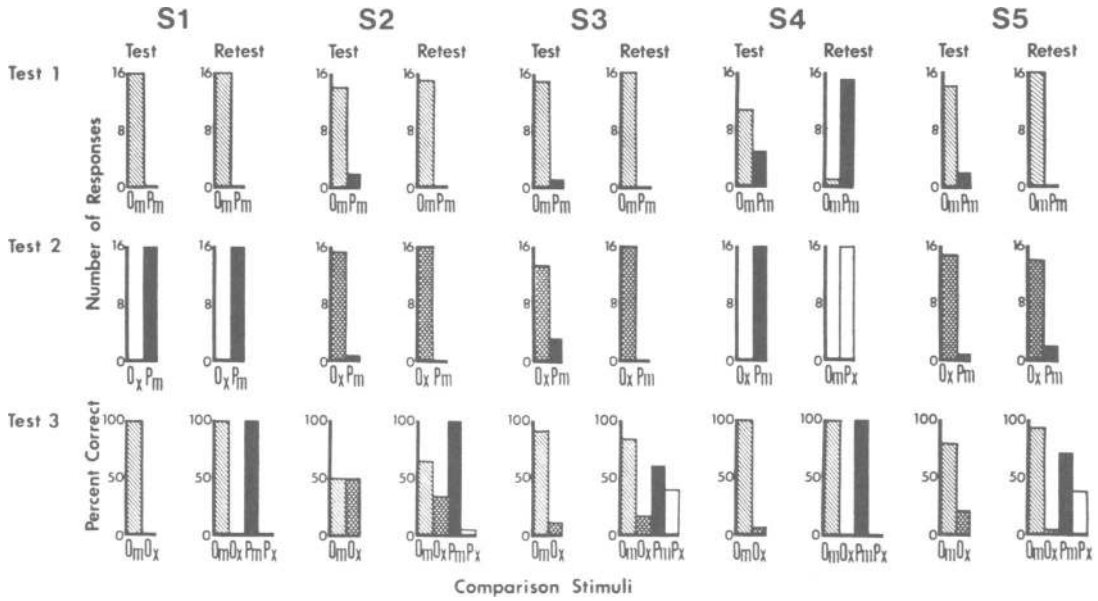


Fig. 4. Results of each student on the initial and retest presentation of each test.

of the edge shape of the object but it also has the flatness and surface information of the photograph.

Figure 4 presents the results of the three tests, the initial tests, and the retests, for each student. The results of the initial presentation of Test 1 are shown in the top row, left column for each student. The data in Figure 4 show a total of 16 responses on the test which were obtained by combining the results of eight trials from the two consecutive sessions in which the test was presented.

On the initial presentation of Test 1, all students matched the object to the cut-out photo more frequently than they matched the complete photo to the cut-out. Four of the five students responded with the object match on 14 of 16 test trials.

*Test 2*

The design of Test 2 was based on the results of Test 1. Given that the students matched the 3D object to the cut-out figure, it is conceivable that the cut-out might function to represent the object. An alternate possibility is that the cut-out figure was responded to as an object per se. That is, in Experiment 1, Students 2, 3, 4, and 5 matched dissimilar objects as opposed to matching an object to its photograph in the classification test. In Test 1 of Experiment 2, they matched the cut-out sample to the matching object as opposed to the matching photo. In Test 2, the students were given a dissimilar object and a matching photo as choices for the cut-out figure sample. If the students selected the matching photo under these conditions, then there would be evidence of how that cut-out figure might relate to both the 3D object and the 2D photo. A programmatic training sequence could then gradually add ground to the cut-out figure to establish the photo-object matching skill. However, if the students matched the cut-out figure to a dissimilar object rather than to the complete photo, it would suggest that the cut-out figure might be classed as an object just as if it were a 3D object.

Two students, S1 and S4, selected the photo match on all 16 test trials. S1 was the student who previously demonstrated photo-object matching in Experiment 1. The subsequent tests with S4, with the object glued to the photo as a sample as well as the cut-out figure as sample,

indicate the selection of the photo match over the mismatching object was due to a bias in selecting a photo choice over an object choice independent of any given sample. The remaining three students (S2, S3, and S5) responded to the mismatching object on 13 to 15 of the 16 trials. The results of these three students on Tests 1 and 2 show the matching and mismatching object were both matched to the cut-out figure versus the photo match. These combined results suggest that the cut-out is a member of the class of objects, rather than a representation of the matching object. From the data shown in Figure 4 for these three students, the results of Tests 1 and 2 might be explained on the basis of response bias to select an object rather than the photo. However, the same students responded to a photo choice as frequently or more frequently than to an object choice when the sample was an object glued to the photo. These data are not presented.

*Test 3*

In Test 3, the students were given the two objects as choice stimuli, a match and a mismatch for the cut-out figure presented as the sample. The purpose of Test 3 was to determine if accurate matching of an object to its cut-out figure would be demonstrated where the students have previously failed to match the objects to the completed photos in the representation assessment of Experiment 1. Selection of the object matching the cut-out sample was reinforced. Selection of the mismatching object resulted in the experimenter removing the stimuli and progressing to the next trial. The two sessions consisted of 10 trials each. The percent correct in Figure 4 is the combined accuracy for the two sessions.

The results of the initial presentation of Test 3 show 80% correct responding or better for four of the five students. Only S2 remained at chance.

*Retest Sequence*

The retest sequence was a direct replication of the three tests for S1, S2, S3, and S5. The performances of these four students were nearly, if not totally, identical to the first presentation. On Test 3, matching the cut-out figure to the matching object as opposed to the mismatching object, the students were given one additional assessment. The completed photos (Pm and Px) were substituted for the two objects as comparison stimuli. Three students, S1, S2, and S4, were 100% correct. S3 and S5 scored 60% and 70% correct, respectively.

Test 2 was changed for S4. S4 had consistently selected a photo choice over the object choice on every trial of every test except the first presentation of Test 1 with the cut-out sample. On the retest sequence, S4 was given the object match and the photo mismatch as choice stimuli. She selected the photo mismatch.

*Reliability recording.* The procedures for recording and calculating reliability were the same as in Experiment 1. At least three sessions for each student were observed for reliability. There was a total of two disagreements between the experimenter and observer in scoring the students' responses. The observer's records showed a total of eight errors by the experimenter across all trials where reliability was recorded. Three errors were, again, reversing the left-right positioning of the comparison stimuli. Two errors were recorded for sequence of trial presentation and incorrect sample presentation. One error was in failing to present an intermittent consequence as scheduled.

## DISCUSSION

The combined results for four of the students in Experiment 2 suggest that a figure cut from a photograph leads to a classification of the figure as a 3D object. Even though two of the students accurately (S3 and S5) matched the figure with the corresponding object over the mismatching object (Test 3), they also continued to match the cut-out figures to the mismatching object over the matching photo on the Test 2 retest. The combined data from S3 and S5 on

these two tests suggest a classification arrangement where the cut-out figures, members of the object class, are: (a) more similar to the matching object than a mismatching object; and (b) more similar to different 3D objects (a mismatch) than to the matching photograph. Such a discrepancy in the matching performances suggests a cut-out figure is not representing the object pictured but is physically more similar to the object pictured than to a different object.

Outer edge shape of a 2D figure apparently was an important variable in the matching performances of at least three of the four students who failed to match corresponding photos and objects in Experiment 1. In Experiment 1, S2, 3, 4, and 5 matched dissimilar photos and dissimilar objects as opposed to matching photos to objects pictured and vice versa. In Experiment 2, the cut-out figures, particularly the banana, contained a similar edge shape to the objects pictured. Here S2, 3, and 5 matched the flat cut-out figure to the 3D objects and not to the photos. Perhaps the use of an object glued to the rectangular photo as a sample resulted in unreliable responding due to the confounding of two edge shapes—the edge of the object and the edge of the photo.

## SOME POSTEXPERIMENTAL DATA AND IMPLICATIONS FOR TRAINING

The purpose of analyzing some of the figure-ground variables in Experiment 2 was to provide an empirical basis for developing a training sequence. The results suggest beginning training with a cut-out sample and two objects (a match and a mismatch) as in Test 3. Once a student is reliably matching objects to the cut-out sample, ground could gradually be added to the cut-outs until the complete rectangular photo was presented. However, such a sequence proved unnecessary for the participants in the current research.

At the end of Experiment 2, the investigator planned to initiate the training sequence suggested above with Students 2, 3, 4 and 5. Matching the objects to the cut-out samples was continued until each student reached 100% accuracy for one session. To determine if the sequence of gradually adding ground to the cut-out figures was still needed, the students were retested on complete photo-object matching. That is, the representation test of Experiment 1 was again presented as a repeated pretest before initiating training. All four students scored 90% correct or better. To assess for generalization of photo-object matching, new objects and life-size, full-color photos of the objects were introduced. All students maintained 90% correct responding or better across all sessions. It is possible that establishing the matching of objects to the cut-out figures was sufficient to maintain control by the figures when the irrelevant properties of ground were abruptly added.

These results raised the question again of relative control by the image of figure in a picture versus the control of the two classes of stimuli. In Experiment 1, the results of the representation vs. 2D, 3D classification assessment and the results of the representation assessment or photo-object matching correlated perfectly. That is, S1 demonstrated photo-object matching on both tests, and the remaining four students failed to demonstrate it on both tests. These four students subsequently demonstrated photo-object matching on the representation assessment. The representation vs. 2D, 3D classification was repeated to determine if there would be a correlated change in performance on that assessment. S3 and S4 were still available as subjects. For S3, the results were identical to the first presentation given in Experiment 1.

S4 also matched dissimilar objects and photos on the first four trials, but then selected the representation match and received a reinforcer. She continued the object-photo matching for the remainder of the session. Even though these students had a recent history of reinforcement for object-photo matching, other aspects of the stimuli still exerted strong control over the performance.

## GENERAL DISCUSSION

The area of picture representation appears to be quite complex. The results of the current study suggest that we need to examine more carefully the assumptions implicitly made in designing programs for severely and profoundly retarded persons. Certainly, the use of pictures should be limited to students who demonstrate picture representation skills if pictures are used at all.

The additional results after Experiment 2 were presented primarily for addressing the broader issues of picture representation and transfer of learning from pictures to objects. For the purposes of the current study, picture representation was defined as photo-object matching, and the results of the study are limited to photo-object matching. When a subject demonstrates photo-object matching it would be erroneous to infer that pictures are equivalent to using objects in other training tasks. The additional data for S3 and S4 on the repeated representation vs. 2D, 3D classification may have implications for the issue of transfer of learning from photos to objects. If the physical properties of the class of photos and class of objects exert more control over responding than the similarities between the image and the object, then there is little support to speculate that these students might demonstrate transfer of learning from pictures to objects. In fact, we might even speculate that there would be more transfer from the pictures used in training to totally different pictures than to the objects shown.

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*Received October 22, 1980*
*Final acceptance May 6, 1981*