DOCUMENT RESUME

ED 165 098 CS 004 576

AUTHOR Furukawa, James M.; Sunshine, Phyllis M.
TITLE Picture Chunking Effects in Concept Learning.
NOTE 14p.; Paper presented at the Annual Meeting of the American Psychological Association (Toronto, Canada, August 1978)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS Cognitive Processes; *Concept Formation; *Educational Research; Elementary Education; *Learning Processes; *Pictorial Stimuli; *Recall (Psychological); Teaching Techniques; *Visual Learning
IDENTIFIERS *Chunking

ABSTRACT

Thirty-three second graders participated in a study to discover the value of teaching concepts using picture attribute chunking (PAC). It was hypothesized that PAC would yield superior concept learning performances compared to a picture attribute list (PAL) treatment and a word-alone treatment. The children, selected on the basis of a pretest that determined their knowledge of the concepts to be learned, were divided into three treatment groups. They were taught 14 concepts and given immediate posttests and delayed posttests of recall and recognition. On the immediate recall posttest, the PAC treatment results were superior to the word and PAL treatments. On the immediate recognition posttest, the PAC was superior to the other two and the word treatment was superior to the PAL. On the delayed recall posttest, there were no significant differences among the treatments. On the delayed recognition posttest, the PAC was superior to the PAL and word treatments. (TJ)

# PICTURE CHUNKING EFFECTS IN CONCEPT LEARNING

JAMES M. FURUKAWA

TOWSON STATE UNIVERSITY
TOWSON, MARYLAND 21204



PHYLLIS M. SUNSHINE

MARYLAND STATE DEPARTMENT OF EDUCATION

Paper presented at the meeting of the American Psychological Association, Toronto, August 1978.

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Abstract

Concepts were taught to 33 second graders using three different methods: word, picture attribute list (PAL), and picture attribute chunking (PAC). The PAC method was found to be superior to the word and PAL conditions. Surprisingly, the PAL method led to the most errors. By themselves, discrete but relevant pictures of dominant attributes of concepts apparently do not facilitate learning. If these same pictures are successively chunked, however, the results showed the least number of errors on both immediate and delayed recognition-type posttests and on an immediate recall-type posttest.

Picture Chunking Effects in Concept Learning

"It may be that the abstraction and generalization involved in verbal concept formation constitute the essential types of intellectual processes involved in reading" (Vernon, 1971, p. 94). Assuming this statement to be true, one way to improve reading fluency appears to be through more effective methods of teaching concepts.

A concept can be defined as "a class of stimuli which have common characteristics" (DeCecco & Crawford, 1974, p. 288). The distinctive features which separates one concept from another are known as attributes, with their values or variations. The attributes combine in at least three different ways to produce conjunctive, disjunctive, and relational concepts. Concepts generally fall into the conjunctive category, where the appropriate values of several attributes are simultaneously present. To illustrate, the dominant attributes of the conjunctive concept tree are: trunk, leaves, and branches, with the trunk, for example, having the attribute values size and bark. These attributes and their values form a hierarchy: the concept at the apex, attributes next, and their values at the base. Because of the predominance of conjunctive concepts, they were selected for investigation.

In searching for effective methods to teach concepts, six suggestions were considered to be meritorious. The first suggestion came from Flavel's (1963) characterization of second graders (the subjects of this study). These children were characterized as being in a stage of development where: (a) operations are oriented towards concrete things and events in the immediate present; (b) physical attributes of the concrete things and events are relin-

quished one by one; (c) groupings of the things and events remain isolated units and are not integrated into a system. Essentially, the child in this stage of development probably should be limited to learning concepts which require the classification of concrete events and objects

The second suggestion was to limit the attributes to dominant (Wallace, 1964) and relevant attributes (Woodson, 1974), and not to ones embedded in perceived materials (Anisfeld, 1968).

The third suggestion was to use an inductive method. Low ability students (WISC IQ's of 95-105) were found to be able to learn concepts better by using an inductive rather than a deductive method (Reference Note 1).

A fourth suggestion was to use imposed pictures (experimenter provided pictures). Pressley (1977) concluded after an extensive review of the literature on the relationship of imagery on children's learning that imposed pictures were almost always learned better than words.

A fifth suggestion was to reduce the burden on memory by using drawings or animated movies instead of direct experiences (Travers, McCormick, Mondfrans, & Williams, 1964). Realistic examples may provide too much information (Travers, 1964).

Finally, a chunking strategy was suggested. In complex prose learning, the test performances of low cognitive processing capacity (CPC) students were found to be superior when a chunking strategy was used (Furukawa, 1977). Also, in reading and spelling, first grade children did best using a chunking strategy in comparison to a whole word and a discrete letter treatment (Reference 2).

These six possible ways of improving concept learning were incorporated in the present study, as follows: (a) concrete con-

cepts were primarily selected, (b) only dominant attributes were considered, and (c) inductive methods were used. These factors were equally applied to all three treatments. The treatments were: word, picture attribute list (PAL), and picture attribute chunking (PAC). The treatments differed in that one had only words, whereas the other two had imposed pictures consisting of line drawings. The final difference was that the PAC also employed a chunking strategy.

It was hypothesized that the PAC would yield superior concept learning performances, followed by attribute list and word, in that order. The rationale for the hypothesis was that, if imposed pictures are a definite asset to learning, then the picture treatment should be better than the word alone treatment, with the chunking of the pictures being best because it should decrease the information load to be processed, stored, and recalled.

Subjects

The subjects were second graders in a suburban school. The students were selected on the basis of a pretest which determined their knowledge of the concepts taught.

Procedure

A total of 24 concepts were initially selected from the American Heritage Word Frequency Book (Carroll, Davis, & Richman, 1971). The concepts chosen were from the 34 to 36 thousand frequency ranks. After a preliminary test of second graders, the following 14 concepts were selected: limousine, billboard, cormorant, pickaxe, rivet, jetty, neckerchief, satchel, poncho, cavalryman, canine, pediatrician, translator, and descendant. The concepts were randomly divided into two sets to be taught in

two separate learning sessions.

A Singer Caramate, Model 8806, was used in testing the children for CPC. Bell and Howell Language Master Audio-Visual Instructional Device, Model 1727, was used to teach the concepts. The device was modified by the attachment of a screen which left an 8 cm opening for subjects to view the cards. The total exposure time per card was restricted to 6 seconds--the time it takes a card to run through the Language Master device.

The materials used included a pretest, a CPC test, Language Master cards, and immediate and delayed posttests. The pretest was a recall test which required the second graders to give at least the three dominant attributes of the concepts. Children who were able to do this for two or more of the concepts were eliminated from further consideration.

The CPC test was one developed by Furukawa and Sunshine (Reference Note 3). It consisted of 25, 35 mm slide reproductions of commonly available objects. The first 5 were used as warmup or practice slides and the other 20 were presented in two sets of 10 slides each, with the average free recall of these pictures becoming a child's CPC score. The children were then rank ordered according to CPC scores and randomly assigned to one of the three treatments.

The Language Master cards for each of the three treatments were designed as follows:

1. Word. (The demonstration concept shown to students prior to the learning of the concepts was knapsack): Visual: Knapsack. A knapsack is a bag for carrying things on your back. Audio: The printed words were read.

2. Picture attribute list. Visual: Separate pictures of a bag, of things, and of a person's back. Audio: Knapsack, bag, things, back.

3. Picture attribute chunking. Visual: Separate pictures of bag, bag of things, bag of things on back. Audio: Knapsack, bag, things, back.

In short, the word treatment consisted only of a sentence which listed the three attributes of the concept, but the other two treatments both had pictures and spoken words. The PAL drawings were of the discrete attributes. In the PAC treatment, however, each succeeding drawing had a new attribute added to the old one(s). The spoken words were, nevertheless, identical for the PAL and PAC treatments.

The immediate and delayed posttests were identical and consisted of two types of tests: a recall and a recognition test. The recall test required the children to describe orally the concept by including all three of the attributes taught for a given concept. The recognition test for each concept consisted of line drawings, with two positive and four negative examples. Each test was printed on a single sheet of paper. Two types of tests were used because of the possibility that the word treatment children would do better on the verbal recall tests since the responses required were identical to the visual and auditory stimuli used in teaching the concepts. The PAL and PAC chilren were expected to do better on the picture recognition test for a similar reason.

During the two training session, spaced a day apart, each one of the cards for a concept was shown three times on the Language Master, making a total of 18 secs of exposure time for each concept.

Immediately after all seven concepts were shown, the subjects were asked for the definitions of all of them. This recall test was followed by a recognition test. A maximum of five learning trials were given to reach a criterion of one perfect recall and recognition of a concept. Succeeding learning trials omitted the learned concept(s). Five days after the second set of concepts was taught, the delayed posttest was administered.

Results

The results are reported in three sections: CPC test, immediate posttest and delayed posttest.

The CPC score for the 33 second graders ranged from 2 to 7, with a mean of 3.92 and a standard deviation of 1.08.

The immediate posttest error frequencies for recall and recognition tests are shown in Table 1. As was to be expected, a greater number of errors was made on the recall instead of recognition test. On the recall test, there were significant differences among the three treatments, $X^2$ (2) = 22.27, $p < .001$. The PAC treatment was superior to both the word, $X^2$ (1) = 10.74, $p < .01$, and PAL, $X^2$ (1) = 21.80, $p < .001$. On the recognition test, again there were significant differences among the treatments, $X^2$ (2) = 52.33, $p < .001$. The PAC treatment was only marginally superior to the word, $X^2$ (1) 3.50, $p < .10$, but was clearly superior to the PAL treatment, $X^2$ (1) = 44.96, $p < .001$. On this test and on this test alone, the word condition was found to be superior to the PAL, $X^2$ (1) = 24.14, $p < .001$.

On the delayed posttest, there were no significant differences among the treatments on the recall test, although the least number of errors continued to be in the PAC condition (see Table 1). The

recognition test was, nevertheless, significant, $X^2$ (2) = 14.02, $p < .001$. The PAC was better than both word treatment, $X^2$ (1) = 6.00, $p < .02$, and PAL treatment, $X^2$ (1) = 14.34, $p < .001$.

Conclusion

The hypothesized superiority of PAC over word and PAL treatments was generally substantiated. This difference was found on both recall and recognition immediate posttests. While the higher performance of the PAC group continued on the recognition delayed posttest, this was not true of the recall delayed posttest. The failure may be attributable to four factors: One, the difficulty of the learning task itself, the difficulty of the test, and the low criterion level of performance accepted during learning. A fourth possibility is the lack of sensitivity of the recall test, as contrasted to other methods of measurement such as recognition and savings. This fact was compounded further as the responses were judged to be unacceptable unless all three attributes taught were included.

On the subject of test differences, it should be noted that the possibility of word treatment children doing best on the recall test was not found. All treatment groups clearly found the recall test to be more difficult than the recognition test.

One somewhat surprising result was the failure of the PAL condition to improve concept learning. Because of findings of relevant, picture-illustrated learning being superior to non-picture learning, the expectation was that the posttest performances of the PAL children would be better than the word only children. In fact, even the word group children were significantly better than the PAL group on the recognition immediate posttest.

Two possible explanations can be advanced for the inferiority

One, younger children tend to see wholes, whereas older children tend to see parts (Elkind, Koegler, & Go, 1964). Consequently, the PAL children may have had extreme difficulty in inductively integrating three separate "wholes" (attributes) to form a concept. This brings us to the second possible explanation. The discrete listing of attributes may have served to increase the information load of the learner. This explanation is given some support by the negative correlations found between CPC scores and test scores of the PAL children. This means that the high CPC children made less errors. The correlations, while not significant because of the small number of subjects (11 per treatment), were nevertheless substantial and accounted for as much as 25% of the variance. The correlations cannot be arbitrarily dismissed because of similar findings in learning a foreign language (Furukawa, 1970) and complex prose passages (Furukawa, 1977). In short, CPC may be a factor which needs to be considered as an individual difference in learning experiments.

One other by-product of the study should be mentioned. That is, the majority of the children clearly had the most difficulty with the abstract concepts (viz., pediatrician, translator, and descendant, especially the last two).

In summary, pictures appear to have a prominent role to play in teaching concepts to young children, provided the pictures are of a limited number of dominant attributes and are presented in progressively chunking sequences. Furthermore, the number of concepts taught at any one learning session probably should not exceed the CPC of the learner. Such a method of teaching concepts may lead to increased learning, and, in turn, to increased reading fluency.

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Table 1. Frequency of Errors on Immediate and Delayed Posttests.

| | Treatments | | | | | |
|---|---|---|---|---|---|---|
| | word | | picture attribute list | | picture attribute chunking | |
| Type of Test | IPT* | DPT** | IPT | DPT | IPT | DPT |
| Recall | 307 | 113 | 343 | 109 | 231 | 93 |
| Recognition | 126 | 36 | 217 | 49 | 98 | 18 |

Note. * IPT = Immediate posttest. Maximum errors possible: 770 (11 subjects X 14 words X 5 trials).

**DPT = Delayed posttest. Maximum errors possible: 154 (11 subjects X 14 words X 1 trial).