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ABSTRACT

This study was divided into two parts: the primary purpose of the visual discrimination study was to examine the relationship between four rebus sizes and discriminability; and the primary purpose of the auditory visual association study was to examine the relationship between four sizes of rebus symbols and the ability to associate them with their aural counterparts. Subjects used in the visual discrimination task were twenty children drawn from the kindergarten class of the Peabody Demonstration School. Twenty rebus symbols were divided into groups of "concrete" and "abstract" and then further divided into four subsets according to size. In the discrimination task the students attempted to match each rebus with an exact duplicate using a teaching machine. In the second experiment, the auditory association study, the same subjects were used. A similar procedure was done with a tape recorder. The results indicated that size was not a significant factor in the number of errors made in discrimination or association, and degree of abstractness was a significant factor in the association study. (TS)

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John F. Kennedy Center for Research on Education and Human Development

EFFECTS OF SIZE AND ABSTRACTNESS OF PICTURE SYMBOLS (REBUSES) ON VISUAL MATCHING AND LEARNING TO LABEL

by

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EFFECTS OF SIZE AND ABSTRACTNESS OF PICTURE SYMBOLS (REBUSES) ON VISUAL MATCHING AND LEARNING TO LABEL*

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INTRODUCTION AND BACKGROUND

What is the effect of size of illustration on learning? This question has been asked for a number of years with no conclusive answers. In the area of reading the hypothesis that size of print has a significant effect on one's ability to read more efficiently has been researched. However the findings have been far from consistent.

It is commonly held that beginning reading material must be printed in very large type. The rationale is that larger size enhances learning. In talking with teachers using the rebus method of teaching reading developed by Woodcock (1966), it was found that many felt the symbols were too small. Rebuses are pictorial representations of words. Size was thought to be a major factor in the learning of these symbols.

Visual discrimination and visual-auditory association are two important aspects of reading. The examination of the effect of size and of abstractness of material on the ability to discriminate and associate can give some

*The research reported herein was supported by Grant HD 973 from the National Institute of Child Health and Human Development.

insight into the question of whether these dimensions have a significant effect on reading.

In the past, studies have dealt with the dimension of size as it effects reading efficiency. These investigations have been centered around type print. Alderman (1938) studied the effects of type size, using six and twelve point, on speed of reading. For all groups of primary children he found that the smaller types were read faster than the larger. He concluded that the practice of printing primary grade textbooks in large sizes seems unwarranted. Gilliland (1943) investigated changes in reading with variation in type size. Reading of average adults was not greatly affected by changes in type size between six and thirty-six point. Dallenbach (1946) studied the accuracy of apprehension and speed of location for dictionary words printed in six and twelve point type. He found that setting words in twelve point boldface is better than six point boldface as words may be more quickly and easily located. Adults and children both preferred the larger type size. Hovde (1930) found that readers prefer large type but their reading rate does not differ from size to size. Tinker and Patterson (1942) studied the influence of size on eye movements. They found that ten point type was read more efficiently than six or fourteen point. Reduced visibility in the smaller, and the fact that more area had to be covered with the larger, made the middle type size the most desirable. Tinker (1928) found the most important characteristics

affecting readability of letters and digits were size, simplicity or complexity of outline, stroke width and vividness of type face, shading and hairlines, area of white space included within the outline, and emphasis or lack of emphasis on differentiating parts. Tinker and Patterson (1942) found that word difficulty is an important factor in reading lower case type. This type should be used for smooth rapid reading. Capitals are preferred for long distance reading. Patterson (1946) compared the speed of reading ten point Cheltenham book print with the speed of reading seven point Ionic No. 5 and eight point Opticon newsprint. Book print was read significantly faster with less errors than both types of newsprint and was judged to be more pleasing. Tinker (1963) compared six through 10 point type and found that readers ranked larger point type as more pleasing and legible. They also read the small size significantly slower than the standard.

Mueller (1962) found that increasing the size of the Peabody Picture Vocabulary Test benefitted children with visual acuity ranging from 10/200 to 20/200. Increasing size did not enhance the performance of children falling in the 20/200 to 20/70 range. He concluded that increasing the size of PPVT would make it appropriate for the more visually limited.

Dunn and Vergason (1964) administered forms A and B of the PPVT in large and small sized plates to 180 preschool pupils. The different sizes were administered in counterbalanced order to the S's which had been divided into younger and older sub groups. The results demonstrated

that illustration size did not affect performance for either the younger or older preschool children.

The research sampled here and overall dealing with type and illustration size as it affects speed and accuracy has been contradictory. Some have found larger sizes are preferable, while others have found smaller sizes are more efficient. Still others indicate size is not a significant factor. The findings are not conclusive to make a judgement about the effects of rebus size. The question of whether size does make a difference in the learning of rebus must be answered empirically.

STATEMENT OF PURPOSE

The first purpose of the visual discrimination study was to examine the relationship between four rebus sizes and discriminability. The second purpose was to examine the relationship between two levels of abstractness and their discriminability. The third purpose was to examine the interaction of size and abstractness as to their effect on discrimination.

The first purpose of the auditory visual association study was to examine the relationship between four sizes of rebus symbols and the ability to associate them with their aural counterparts. The second purpose was to examine the relationship between two levels of abstractness and the ability to associate them with their aural counterparts.

Visual Discrimination Study

Method

Subjects. Subjects used in Experiment I, the visual discrimination

task, were drawn from the kindergarten class of the Peabody Demonstration School. Twenty children were randomly selected from this group. All subjects were non readers.

Subjects had no previous experience with the apparatus used. The situation and procedure was also new to them. None of the group had prior exposure to rebus. The mean age was five years 11 months with a standard deviation of two months.

Materials. Twenty rebus symbols were selected from those now being used. The original size currently used in the rebus workbook was called the 100 percent size. Three other sizes were also used. Figure 1 shows rebuses used in Experiment I. The rebuses were divided into "concrete" and "abstract". The concrete were clear pictorial representations of some object while the abstract were meaningless geometric designs.

Insert Figure 1 about here.

These symbols were divided into four subsets. Five symbols were in each subset. These subsets were reproduced at 25 percent, 50 percent, and 200 percent of the original size. A particular subject was exposed to all four subsets. Each subset was presented at a different size. The combination of subset to size was counterbalanced among subjects to allow each of the twenty symbols to appear in each of the four sizes.

Apparatus. The discrimination task was presented by means of the MTA Scholar Teaching Machine. The subject sat at a table with the machine directly in front of him. The symbol was seen above four choices, one of which was the exact duplicate as shown in Figure 2. The subject attempted to match the stimuli with one of four choices. Over each choice there was a window. At each stimulus presentation the subject responded by pressing the window to indicate his choice. Only after he correctly matched them did the rebuses move on. The symbols were presented in a scrambled sequence and the criterion for being correct was two times through the list without error. When this was reached, the subject was finished.

Insert Figure 2 about here.

The amount of incident light was 23 foot candles. This was measured by a General Electric light meter model 8DW5844. The amount of available illumination exceeded 70 foot candles - the maximum sensitivity of the instrument.

Procedure. This experiment lasted five days. Each subject came for only one day. Four subjects per day were brought one at a time to a room located 75 yards from the classroom. The time was kept constant, 10:00 - 12:00 to guard against differential performance because of fatigue. Along the way, each subject was told by the experimenter that he was

going to play a game after which a prize would be given.

A practice program was given before starting the study. The subjects were told to "find the picture on the bottom that was the same as the one on the top and then press the glass". The practice program consisted of circles, pictures of animals, and fruits. After the subject made ten correct responses on the practice program, the discrimination task began.

The examiner recorded incorrect responses by means of pencil and paper. Each time an incorrect window was pushed, it was counted as an error. Latencies were recorded as all responses taking more than four seconds. A stopwatch was used to keep track of time. A subject was finished with the task when he made 20 correct responses with no delay greater than four seconds.

Each subject took approximately 14 minutes to go through the task. The fastest was seven minutes and the longest 24 minutes. Upon completion of the discrimination task, the subject received an extrinsic reward. He was given a choice between a bag of M&M's or a balloon.

Results

In the visual discrimination study, the two dependent variables were number of errors and latency of response. A two way analysis of variance was used to examine the data for both dependent variables. Significant differences were tested for three dimensions. These included the four randomly constituted groups of subjects, the four sizes and the concrete-

abstract dimension. The statistical design of this study is pictorially represented in Figure 3.

Insert Figure 3 about here.

Table 1 shows the mean number of errors for each dimension. Also represented are the means for each interaction. The mean number of errors for concrete symbols was 1.17, while the mean number of errors for abstract symbols was 1.56. Symbols in the 25 percent size group had 1.60 errors compared to 1.65 for 50 percent, .90 for 100 percent and 1.33 for 200 percent.

Insert Table 1 about here.

Table 2 shows the analysis of variance values for the dependent variable. No significant differences were found within or between the dimensions at the .05 level of significance.

Insert Table 2 about here.

Table 3 shows the mean number of latencies for each dimension. The means for each interaction can also be found here. A comparison of the means per symbol between sizes shows the 100 percent size had .83

latencies per symbol. This is followed by 200 percent with 1.03, the 25 percent with 1.55 and the 50 percent with 1.65 latencies per symbol.

Insert Table 3 about here.

Table 4 shows the analysis of variance values for latencies. Performance differences related to size were found to be significant to the .05 level. No significant differences were found within the other dimensions.

Insert Table 4 about here.

A t-test was applied to the dimension of size comparing it in all possible combinations. Scheife's "critical difference" formula was used to compute the score necessary to reject the null hypothesis at the .05 level. Significant values were obtained when comparing the .25 size with the 1.00 size and when comparing the .50 size with the 1.00 size. In both comparisons the subjects had fewer latencies with the 100 percent symbol. Table 5 shows the values obtained and the critical value needed.

Insert Table 5 about here.

The Auditory Association Study

Method

Subjects. The 20 subjects who appeared in the previous task were used in the association study. Subjects all now had previous experience with the MTA Scholar Machine. The procedure was, however new to them.

In addition to the MTA Scholar Machine a tape recorder was also used. A pacer button connected to the teaching machine was held out of view of the subjects.

Materials and Apparatus. The rebuses were shown by means of the MTA Scholar Machine. The picture moved on after four seconds by means of a pacer button operated by the examiner. The first time through the list, the child was told by prerecorded tape, the name of each symbol. During the ensuing trials, the subject had four seconds to identify the symbol. After four seconds, the answer was given by means of tape. The examiner then pushed the pacer button and the rebus moved on.

The amount of incident light was again 23 foot candles as measure by the General Electric Lightmeter. The amount of available light exceeded 70 foot candles.

Errors were scored if the subject's first response was incorrect, or if he failed to respond before being told the answer. Paper and pencil were once again used to record the errors.

Procedure. Four groups were randomly constituted from the 20 subjects. They were distributed in 25, 50, 100, and 200 percent groups.

This study tested the subjects' ability to associate rebuses with their spoken counterpart, when the rebuses were presented at different sizes. Eight new symbols were used for this experiment. Figure 4 shows the symbols in varying sizes. Each subject was exposed to all symbols at only one size. The rebus was abstract and concrete in both picture and language usage for the purpose of this study. The design is pictorially represented in Figure 5.

Insert Figure 4 about here.

Insert Figure 5 about here.

The child was required to identify the picture before him. He was asked to give the exact name previously told to him. Sixteen correct responses in succession was defined as learned association. When this was reached, the experiment was over for that subject.

This task was done one week after the first. The subjects were transported to the same room in the same way as before. They were told that they would "once again play a game with the machine." Each subject took approximately 17 minutes to go through the study. The range was nine to 31 minutes. Upon completion of the task, the subject received his choice of M&M's, whistles, comic books, or balloons.

Results

In the auditory association study the dependent variable of errors was tested. The independent variables used included size and abstractness of rebus.

A two-way analysis of variance was used to test the significance of performance differences related to size and abstractness of symbol. A comparison of means for these two variables are shown in Table 6.

Insert Table 6 about here.

Table 7 shows the summary of results for the dependent variable of errors. No significant differences were found between sizes. The performance differences were significant at the .05 level when related to the dimension of abstractness.

Insert Table 7 about here.

Discussion and Conclusions

The purpose of this study was to examine the effect of size and abstractness of symbols on the ability of beginning readers to visually and auditorally discriminate them. A second purpose was to see if size or abstractness affect the learning of rebus symbols. The results indicated that size is not a significant factor in accuracy of discrimination

or association. Degree of abstraction was not significant in the discrimination task. It was however, significant for the association task. Size did play a role in amount of time spent on each rebus size. This is not a linear relationship. The ideal size was the 100 percent symbol as it appears in the rebus workbook.

These results parallel the findings of Dunn (1964) who investigated the effect of two sizes of PPVT plates. The results are also in accord with Mueller's (1962) findings when he manipulated size of illustration with the slightly visually handicapped.

A practical implication of this study is that altering the size of rebus as it appears in the workbook is not necessary and will not enhance the performance. Adults, upon viewing the smallest size, felt that this was almost invisible. The printer at first refused to print the 25 percent because he felt it was much too small to be seen by the human eye. This notion on the part of adults does not seem to be shared by children.

These studies were done with middle class children. A replication with lower class subjects might well point up some undetected visual problems. A hard of hearing child would be greatly handicapped in the auditory association task. Some undetected hearing problems might also be uncovered.

A final variable which played a great part in the results was concentration on the part of the subjects. It was apparent to the examiner from observing facial expressions that the smaller symbols

received greater concentration. A study using physiological measures of concentration seems warranted to find out how important this variable is.

SUMMARY

These studies measured the effect of size and abstractness of rebus symbols on visual discrimination and auditory association. Twenty kindergarten children participated. In the discrimination task they tried to match a rebus symbol to one of four others containing its duplicate. In the association study the subjects matched a rebus symbol with its aural counterpart. An MTA teaching machine presented the symbol and a tape recorder presented the aural counterpart. In each study symbols were presented at four different sizes in a concrete and abstract form.

The results indicated that size was not a significant factor in amount of errors made in discrimination or association. Size was significant in amount of time taken in the discrimination task. The regular size as it appears in the rebus workbook fared best. Degree of abstractness was a significant factor in the association study. The abstract symbols were missed 40 times more than concrete.

A conclusion drawn was that changing the size rebus is printed in will not enhance performance. A suggestion was made for further research on size as it effects concentration.

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Table 1

The Mean Number of Errors Per Symbol for Each Dimension and Each Interaction in the Visual Discrimination Study

Group	Percent of Standard Size				Totals
	25	50	100	200	
I:					
Concrete	2.40	1.80	.80	1.00	1.50
Abstract	1.20	2.00	.80	2.00	1.50
Total 5	1.80	1.90	.80	1.50	1.50
II:					
Concrete	1.00	1.80	1.00	1.20	1.25
Abstract	3.60	2.00	.00	1.80	1.85
Total 5	2.30	1.90	.50	1.50	1.55
III:					
Concrete	.60	.60	.80	.40	.60
Abstract	2.00	1.60	.80	1.60	1.50
Total 5	1.30	1.10	.80	1.00	1.05
IV:					
Concrete	1.00	2.00	1.00	1.40	1.35
Abstract	1.00	1.40	2.00	1.20	1.40
Total	1.00	1.70	1.50	1.30	1.37
Grand Totals:					
Concrete	1.25	1.55	.90	1.00	1.17
Abstract	1.95	1.75	.90	1.65	1.56
20	1.60	1.65	.90	1.33	1.36

Table 2

Summary Table for Dependent Variable of

Errors in Visual Discrimination Study

Source	SS	DF	MS	F-RATIO	P.05
Groups	6.6069	3	2.023		
SBS/GP	54.050	16	3.378		
SIZE	14.169	3	4.723	2.537	.067
GS	15.106	9	1.678		
SXSBS/GP	89.350	48	1.861		
ABST (C-A)	6.006	1	6.006	1.667	.21
GA	5.719	3	0.906		
AXSBS/GP	57.650	16	3.603		
SA	3.519	3	1.713		
GSA	25.856	9	2.873	1.503	.17
SAXSBS/GPS	91.750	48	1.911		
Total	369.244	159	2.322		

Table 3

The Mean Number of Latencies per Symbol for Each Dimension and Each Interaction in the Visual Discrimination Study

Group	Percent of Standard Size				Totals
	25	50	100	200	
I:					
Concrete	1.40	1.40	.80	1.00	1.15
Abstract	2.00	1.20	.40	.80	1.10
Total 5	1.70	1.30	.60	.90	1.13
II:					
Concrete	1.80	2.40	1.20	1.60	1.75
Abstract	1.40	1.60	1.20	1.00	1.30
Total 5	1.60	2.00	1.20	1.30	1.53
III:					
Concrete	1.20	1.60	.80	.60	1.05
Abstract	2.40	2.20	1.00	1.20	1.70
Total 5	1.80	1.90	.90	.90	1.37
IV:					
Concrete	.80	1.20	.60	.80	.85
Abstract	1.40	1.60	.60	1.20	1.20
Total	1.10	1.40	.60	1.00	1.03
Grand Totals:					
Concrete	1.30	1.65	.85	1.00	1.20
Abstract	1.80	1.65	.80	1.05	1.32
20	1.55	1.65	.83	1.03	1.26

Table 4

Analysis of Variance Values for Latencies

in Visual Discrimination Study

Source	SS	DF	MS	F-RATIO	PROB
Groups	6.275	3	2.092	1.918	.167
SBS/GP	17.450	16	1.091		
SIZE	19.225	3	6.408	16.94	0.001
GS	3.875	9	.431	1.139	.355
SXSBS/GP	18.150	48	.378		
ABST (C-A)	0.625	1	.625		
GA	6.875	3	2.292	2.767	0.0757
AXSBS/GP	13.250	16	.828		
SA	1.925	3	.642	1.225	0.311
GSA	2.175	9	.242		
SAXSBS/GPS	25.150	48	.524		
Total	114.975	159	.723		

Table 5

Results of "t" Test Using Scheffe's Critical t

Means

25 percent = 1.550

50 percent = 1.650

100 percent = .825

200 percent = 1.025

	50 Percent	100 Percent	200 Percent
25 Percent	.100	.725*	.525
50 Percent		.825*	.625
100 Percent			.200

Table of Differences for Latencies Between Sizes

$$d = t\sqrt{\frac{2\ MSW}{N}} = .696$$

* Significant to .05 level.

Table 6

The Mean Number of Errors Per Symbol for Each Dimension and Each Interaction in Auditory Association Study

Abstraction	SIZE .25	.50	1.00	2.00	Total
Concrete	.80	.00	.20	.60	.40
Abstract	18.20	16.40	12.20	15.80	15.65
Total	9.50	8.20	6.20	8.20	8.00

Table 7

Analysis of Variance Values for Auditory Association Task

Source	SS	DF	MS	F-RATIO	PROB
Size	55.675	3	18.558		
Sbj/size	612.800	16	38.300		
Abstractness	2325.625	1	2325.625	81.673	0.001
(AS)	41.275	3	13.758		
Subj X Size/Abst	455.600	16	28.475		
Total	3490.975	39	89.512		

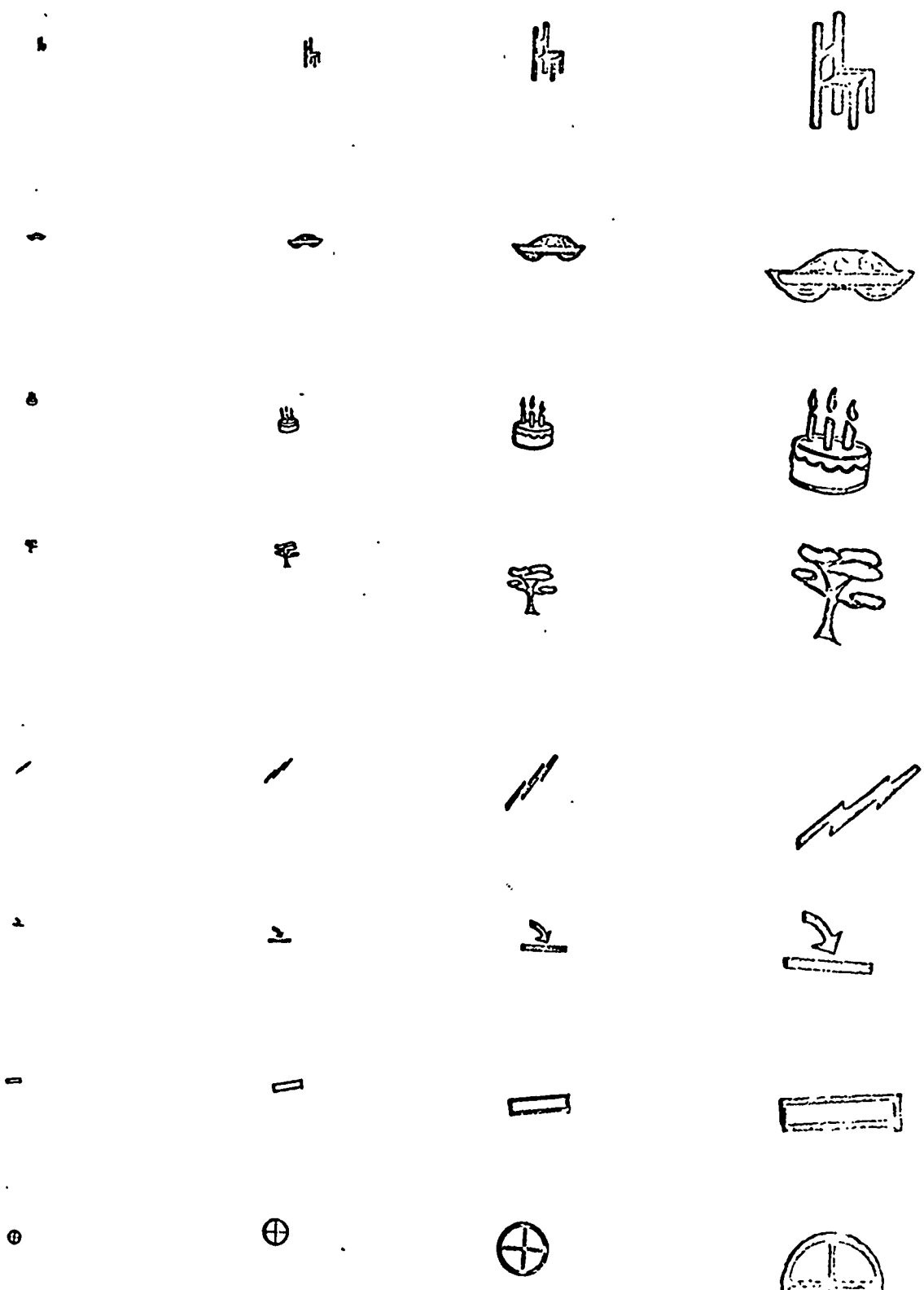

Fig. 1 Examples of some symbols used in the visual discrimination study

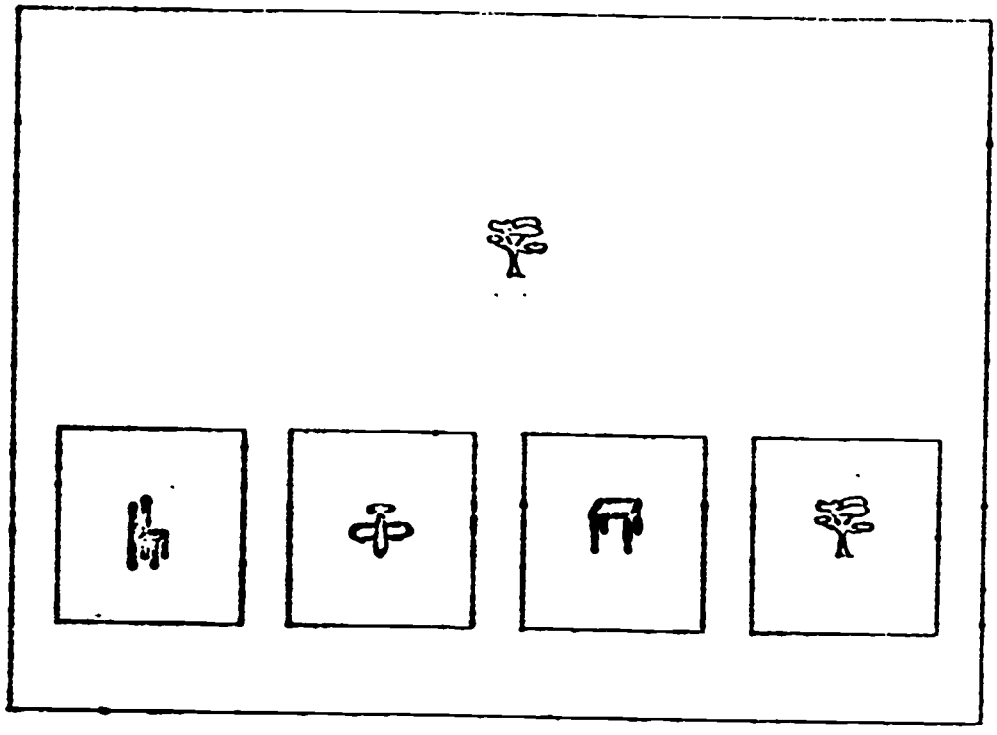

Fig. 2 In the visual discrimination study, the symbol was seen above four choices. One of these choices was the exact duplicate.

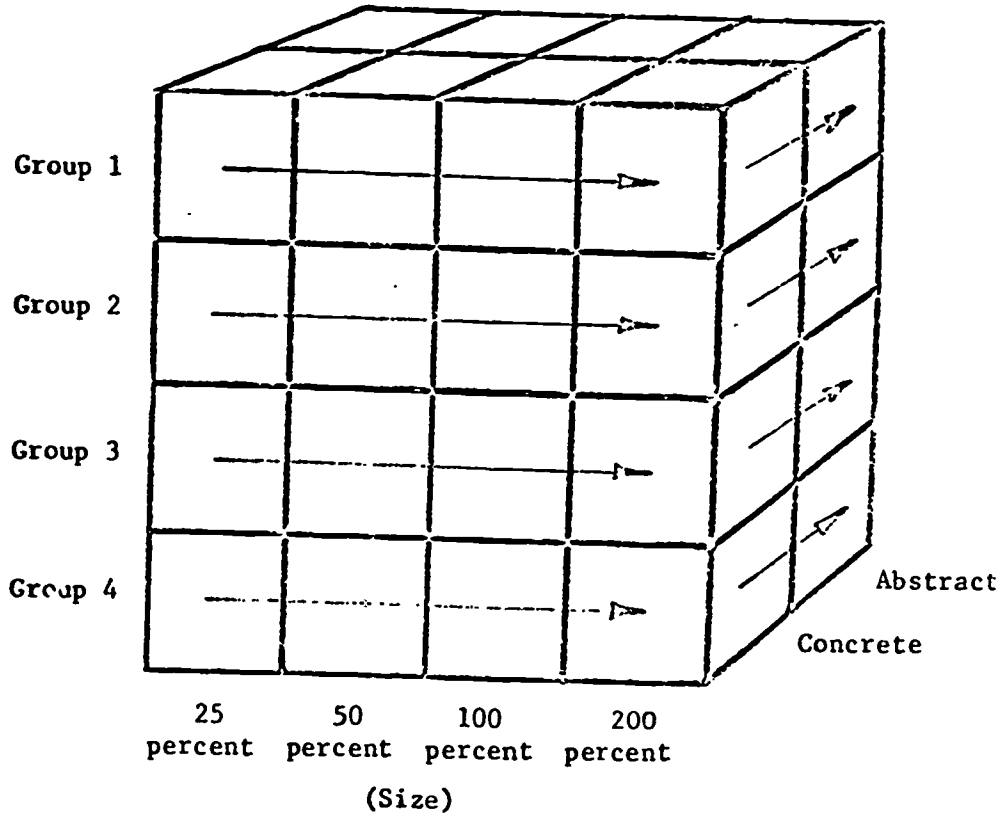

Fig. 3 A statistical design of discrimination study

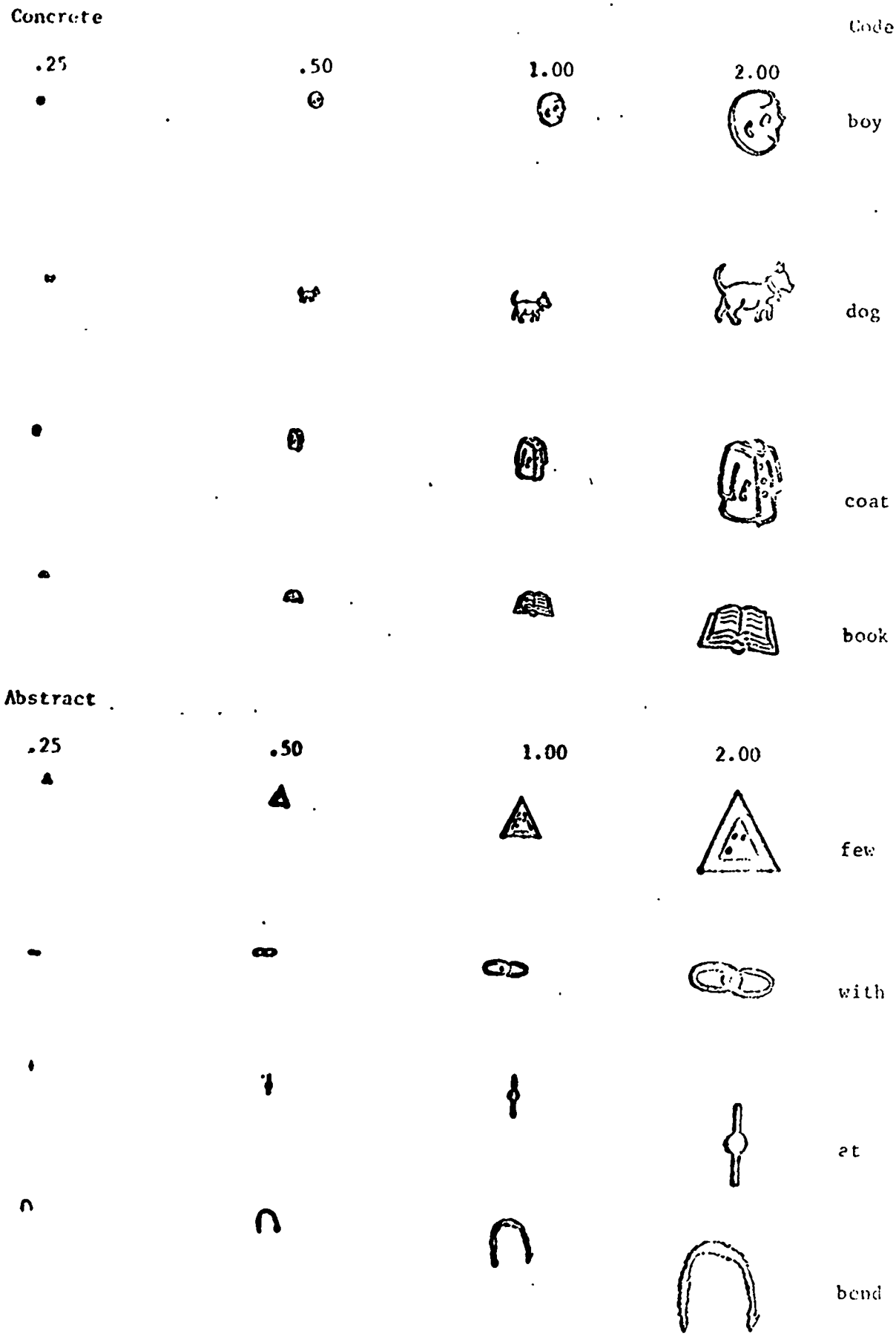

Fig. 4 Symbols used in the auditory association study shown at all sizes.

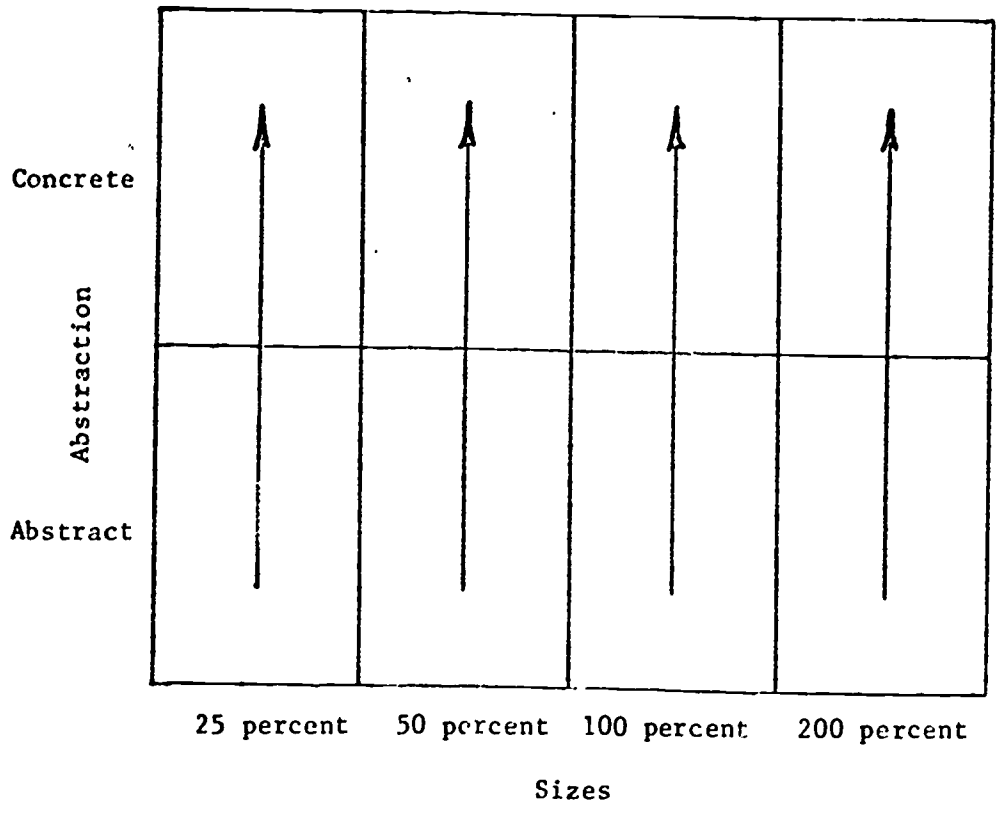

Fig. 5 A pictorial representation of auditory association study