HAYWOOD, KAREN LUCILE. The Role of Meaningfulness in Paired-Associate Recognition Learning of Trainable and Educable Mental Retardates and Normals. (1972) Directed by: Dr. Herbert Wells. Pp. 56

Current literature points to meaningfulness as vital in the learning process. This study concentrated on the effect of meaningfulness on the performance of 30 high school students: 10 trainable retardates, 10 educable retardates, and 10 normal Ss, on a paired-associate task designed to minimize the effects of response learning. Stimuli were four sets of silhouette cards. The Ss responded on a specially designed response board, selecting their response from an array of six possible items, loaded for meaningfulness (V) or nonmeaningfulness (N). Sets were grouped VV, VN, NV, and NN. Meaningfulness was found to be significantly related to learning at all levels, most effectively as the stimulus item. All Ss responded to the V items by generating labels for a greater proportion of these items than for N items. Learning took place across trials in all groups.

The Role of Meaningfulness in Paired-Associate Recognition Learning of Trainable and Educable Mental Retardates and Normals

by

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'11

A Thesis Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Master of Arts

Greensboro
April 1972

Approved by

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APPROVAL SHEET

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April 12, 1972
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ACKNOWLEDGEMENTS

I wish to express my sincere thanks to my adviser, Dr. Herbert Wells, and to the members of the Committee, Dr. Kendon Smith, Dr. Sunnan Kubose, and Dr. Wallace Phillips, for their aid in the completion of this thesis.

Deepest appreciation is extended to Mrs. Shirley W. Jordan for her art work, and to Mrs. Doris Reid for her helpful criticism of the paper.

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INTRODUCTION

With today's emphasis on education and learning, considerable attention has been turned to the mentally retarded. Although it is well known that the mentally retarded can learn much of the same material as can normal children, it is obvious that their learning does pose a special problem to educators. Factors such as brief attention span, difficulty in formulating relationships, and in learning abstract concepts make it imperative to determine those elements which facilitate the learning process. Meaningfulness is such a factor.

The role of meaningfulness in verbal learning has been studied by many experimenters in both education and psychology. Although the preponderance of work centers on the learning of normal Ss, some work has been done with mentally retarded Ss. All reports indicate that normal Ss perform at a superior level. In studying the rate of learning of both mentally retarded and normal Ss, Dunn (1960) concluded that the rate of learning of the mentally retarded cannot be compared with that of normals because of a performance "ceiling" imposed by limited intelligence. Other experimenters found the analysis of the performance of these two groups not to be precluded by a ceiling. Drew (1968) studied the performance of mentally retarded and normal Ss on high- and low levels of meaningfulness in paired-associate (P-A) items. Both groups performed better on items with high meaningfulness, but overall performance supports the hypothesis that normal Ss are

able to form associative responses more spontaneously than do retardates. These data support the results and the hypothesis of Wallace (1964), who stated his conclusions in terms of probability, that implicit associative responses are less likely from the mentally retarded.

The ability of the mentally retarded to perform P-A tasks is not questioned. However, their use of information provided by stimulus items is characteristically inferior to that of normals. Baumeister and Berry (1965) employed words and CVC trigrams as stimulus items and numbers as response items. Context clues (colors) were provided as an aid to learning. For normal Ss the context clues did facilitate learning on items of low meaningfulness, but not on more meaningful items. However, the performance of the mentally retarded Ss was unaffected by the addition of context clues. The authors concluded that retardates were unable to utilize various dimensions of the stimulus. Baumeister, Berry, and Forehand (1969) replicated this experiment and obtained similar findings. Achenbach and Zigler (1968) matched mentally retarded and normal Ss for mental age. The Ss used non-verbal items in a P-A task. Their performance was essentially equal. Irrelevant information added to the task was more easily managed by normal Ss than by the retarded, who were less able to eliminate this information from consideration. However, with additional training, the retarded were eventually able to handle even this type of material.

It would seem then that one critical factor in studying the retarded is the extent and type of training provided. A second area

of great importance is the type of items used in the task. Several experiments have shown that retardates respond well to objects and pictures, over the more traditional verbal materials (Iscoe and Semler, 1964, and Jensen and Rohwer, 1963). Wicker (1970) found photographs and drawings to be superior to nouns as stimuli, but did not find a predicted difference between photographs and drawings. Apparently the performance of mentally retarded Ss is generally facilitated by non-verbal stimuli, and generally hindered by verbal material.

It appears then that the study of various aspects of learning of the mentally retarded is quite possible, but that many very pertinent areas of verbal learning have not yet been examined in relation to this type of subject. One must turn then to the studies of Ss with normal intelligence to survey findings related to specific aspects of verbal learning.

Kintsch (1970) states broadly that, "Meaningfulness facilitates verbal learning," but he adds that the nature of the effect depends largely on how the meaningfulness is measured. Martin (1968) postulated that stimuli are perceived differently on different occasions. These different perceptions lead one to attach meaningful labels to the stimuli. "The label presented by the experimenter tends to 'channel' the stimulus function of the figure in the direction of the concept represented by the label." (Carroll, 1964.) It is the concept which is remembered, not necessarily the stimulus item itself. Carroll states further that, "subjects who are not shown any verbal label will invent their own labels..." and these labels, whether generated by the

subject or by the experimenter, refer to a concept, having some meaning for that particular subject.

At present the field of verbal learning is in a "stage of analysis." (Underwood, 1964.) The current trend is to study molecular behavior; the trend of the future is toward the study of more complex, molar behavior. Studies of meaningfulness in verbal learning have frequently employed a paired-associate learning paradigm. Probably the most common techniques employed have involved the use of nonsense syllables, and frequently the CVC (consonant-verb-consonant) trigram. Glaze (1928) investigated possible differences in the meaningfulness of nonsense syllables and found that some are actually more meaningful than others. The relative meaningfulness of such stimuli was studied by Noble (1952), who developed a scale of meaningfulness based on the frequency of associations offered by subjects. Archer (1960) considered all possible CVC trigrams and had his subjects rate the number of associations they attributed to the stimulus items.

Studies such as these led other experimenters to question: if meaningfulness affects learning, where is this effect greatest? Cieutat and Noble (1958) studied the performance of subjects confronted with items of high or low meaningfulness in both stimulus and response positions of the P-A paradigm. Their results showed meaningfulness to have a significant effect in both positions, but a larger effect as a response item than as a stimulus item. In this same regard, Hopkins and Schulz (1969) utilized paired associates with high-, medium-, and low meaningfulness, and studied their effects as stimulus (S_1) and

response (S_2) items. However, they used a P-A recognition technique in order to minimize the need for response learning. The results of their study show that in the P-A recognition paradigm variations in the degree of meaningfulness of S_1 (S_1M) had a greater effect on performance than did variation in S_2M. These results are in direct contrast with those in the so-called standard paradigm, where the effects of S_2M have been found to be greater. These findings relate to a conception of P-A learning as a two-phase phenomenon. Using a standard P-A experimental paradigm, Underwood and Schulz (1960) found the effects of S_2M to be greater than those of S_1M, and attributed this discrepancy to the involvement of S_2 both in response learning and in the association phase of P-A learning. On the other hand, these authors assert, S_1 is involved only in stimulus learning.

After considerable study, some experimenters have amassed evidence on both sides of the experimental question, asserting a greater effect for each variable, S_1M and S_2M, depending on the design of the experiment. Some have obtained results indicating the effects of S_1M and S_2M to be equal. In 1960, Underwood and Schulz hypothesized the effect of meaningfulness to be equal in both the stimulus and response positions. Horowitz (1962) obtained similar results using a matching technique designed to reduce the effect of response learning. Using the same experimental technique, Cuddy and Arbuckle (1967) also obtained results showing equal effects for S_1M and S_2M.

In studies specifically designed to minimize the role of response learning, results show S_1M to have a greater effect on

performance than S_2M. (Cieutat, 1961; Epstein and Streib, 1962; and Epstein, 1963.) In standard P-A experimental designs, where both response learning and association learning are required of the subjects, the effects of S_2M are found to be greater than those of S_1M. (Cieutat, 1958; Martin, Cox, and Boersma, 1965; and Goss and Nodine, 1965.) These experimental findings were surveyed by Hopkins and Schulz (1969), who attributed these experimentally opposing results to the failure of the experimenters to actually control the effect of response learning. In cases where the experiments employed the matching technique the effect of response learning was reduced, but other questions were raised by the fact that the presentation of stimuli was unpaced, and the subjects had to consider all possible pairs at once.

It seems then that the study of the varying effects of meaningfulness merits further investigation in order to determine those factors which bear on efficiency in learning.

Aims of the Present Study

The present study dealt with two specific questions: 1) What is the role of meaningfulness in the P-A learning of the mentally retarded, as compared to that of normal Ss? and 2) Can both educable and trainable Ss perform successfully on tasks of P-A learning?

The principal intent of the present study was to assess the effect of the locus of meaningfulness within P-A items, as stimulus or response, and in items where meaningfulness was present in both stimulus and in response, and where meaningfulness was minimized in both.

A second aspect of the study was directed towards confirmation of the postulate that the mentally retarded, both educable and trainable, can perform P-A tasks, as indicated by improvement in their performance across sessions.

It was expected from the outset that in addition to these two aspects, the results of this study would confirm an anticipated superiority in the performance of educable Ss over that of trainable Ss, both across trials and over all combinations of meaningfulness, and an even greater superiority in the performance of normal Ss.

METHOD

Subjects

Ten educable and ten trainable students enrolled in a special education high school were selected from a population of a little more than three hundred students. Selections were made using the following criteria for I.Q. scores: I. Q. 30 - 50 for trainables, and I. Q. 65 - 75 for educables. This selection allowed a span of fifteen points between groups, insuring a definite difference between the two in spite of error present in psychological tests, and other extrinsic factors. The mentally retarded Ss had been tested on the Wechsler Intelligence Scale for Children, the Wechsler Adult Intelligence Scale, or the Stanford-Binet. Ten normal Ss were selected from a neighboring high school. Of each group of ten Ss, five were boys and five were girls, selected randomly from the I. Q. ranges indicated. Table 1 shows the mean I. Q. for each group of mentally retarded Ss. Each S participated in the study for each of the four experimental conditions, working with each of the four sets of drawings which had been designed as stimulus and response items. All Ss were able to meet the criterion, and no alterations in the subject selections were necessary.

Stimuli

The stimulus and response items were line drawings, filled in as silhouettes. Half of the items represented commonly known objects: half were abstracts. All items were equated for difficulty by balancing for all meaningful and abstract drawings the number of turns involved, and

by maintaining symmetry in the drawings. (See Appendix 1 for reproductions of the drawings.) Those drawings representing commonly known objects were said to have verbal content, and are represented hereafter as V. The abstract drawings were considered non-meaningful, and will be represented as N. The items were paired in four sets of six cards: VV, VN, NV, and NN. These four sets were presented in random order, both initially and over trials (to minimize the effect of order). Each set was presented on a separate day.

Procedure

Training Phase. Ss were shown the six cards first the S_1 side, showing just the S_1 drawing, then the S_2 side, showing both the S_1 and S_2 drawings. They were also shown the response strip, placed on the response board. (See Appendix 2 for a drawing of the response board.) Each was then instructed to indicate his response by pressing the appropriate button. A light came on, indicating to the examiner the S's response.

Test Phase. The Ss were next shown the S_1 side of the card, and were instructed to press the appropriate botton. In reply to correct responses the examiner said, "Yes, good for you," in reply to incorrect responses the examiner said, "No, you'll have to think about that one." In either case the card was turned over and both the S_1 and S_2 drawings were shown for three seconds. The next card was then placed on top of it, and S responded to the new S_1. The Ss continued through all six cards of the set. If any errors had been made during the presentation, the cards were shuffled and presented again. This procedure was continued until one complete correct trial was attained.

Scoring Procedures. The Ss were scored on two measures, 1) time to criterion, and 2) trials to criterion. Time was counted in seconds from the time of presentation of S_1 to the S's response to S_2, and accumulated over the number of trials required to reach a criterion of one complete correct repetition for each group of drawings. This time was then divided by the number of trials to obtain an average score. To aid the scoring procedures, scoring sheets were prepared on which to record the raw data. Average time to response (mean response latency) was selected as the experimental measure, since trials merely reflected this factor, $r_{(28)} = .492$.

Labelling of Items. After the Ss reached a criterion of one complete correct trial, they were asked to identify the test items. They were asked, "What is this?" If they could not label the item they were encouraged, "What does it remind you of?" Responses were considered to be labels if they were in noun form, "It is a _____." However, descriptive responses merely citing characteristics of the item were not considered to be actual labels.

RESULTS

This study shows that the effect of meaningfulness, I. Q. level, and the interaction of these two factors showed a definite influence on the performance of the Ss participating in the study. The table of means and the data for the analysis of variance are presented in Tables 2 and 3. Intelligence served as a definite factor contributing to the Ss performance, with normals obtaining the highest scores, educables achieving a lesser standard of performance, and trainables performing at the lowest level.

In further analysis of these data, mean performance and t-tests of specific aspects show some definite trends, as shown in Tables 4 and 5. For normal and educable Ss, meaningfulness as provided by the stimulus and response items (VV) resulted in superior performance over paired nonmeaningful (NN) items, $t_{(9)} = 3.47$, $p < .01$, and $t_{(9)} = 4.30$, $p < .01$, respectively. However, the performance of the trainable group showed the narrow margin of superiority of the meaningful items (VV) to be no greater than chance, $t_{(9)} = 0.84$, $p < .10$.

Tables 4 and 5 present a further analysis of the data for all Ss. A comparison was made of performance for pairs in which V and N functioned as the stimulus or response. The performance for V items, (VV+VN) - (NV+NN), or $V_1 - N_1$, was considerably higher than that for N items, $t_{(29)} = 14.25$, $p < .01$. A comparison of V and N as response items, (VV+NV) - (VN+NN), or $V_2 - N_2$, also showed superior performance

for the V items, $t_{(29)} = 6.14$, $p < .01$. Overall, meaningfulness was more effective as a stimulus than as a response item, $V_1 - V_2$, $t_{(29)} = 2.08$, $p < .025$.

Apparently the meaningfulness of V items was recognizable, even to the retarded Ss. Both educable and trainable Ss were able to generate labels more frequently for V items, $t_{(9)} = 13.49$, $p < .01$, and $t_{(9)} = 13.72$, $p < .01$, respectively. These data are given in Tables 4 and 5.

Over the four trials each group improved in performance, regardless of the nature of the pairings of stimulus and response items. These data are presented in Tables 6 and 7.

Examination of the strength of test (estimated ω^2) for these t-tests revealed a wide range of data, as shown in Table 8. Extremely high relationships were found in comparison two, where V and N are compared as stimulus items, $\omega^2 = .901$, and in comparison five, where mentally retarded Ss generated labels for V and N items, trainables: $\omega^2 = .823$, and educables: $\omega^2 = .901$. More moderate relationships were found in the comparisons of 1) V and N as response items, $\omega^2 = .647$, 2) overall measures of the effectiveness of V and N, educables: $\omega^2 = .647$ and normals: $\omega^2 = .356$, and 3) learning over trials, trainables: $\omega^2 = .341$, educables: $\omega^2 = 2.84$, and normals: $\omega^2 = .206$. Less strength was found in the comparison of V as a stimulus where N functions as a response item, $\omega^2 = .143$.

TABLE 1

Mean I. Q. Levels

I. Q. Group	Girls	Boys	Total
Educable	70.8	71.0	70.9
Trainable	43.8	43.6	43.7
Total	57.3	57.3	57.3

TABLE 2

Mean Response Latency to Criterion (in seconds)

Source	VV	VN	NV	NN
Trainable	38.90	29.99	38.42	40.59
Educable	15.66	27.77	35.66	40.01
Normal	10.28	25.01	29.78	33.24

TABLE 3

Analysis of Variance: The Overall Effects of Meaningfulness

Source	SS	df	MS	F
I. Q. Levels	3394.52	2	1697.26	6.85**
Error 1	6692.46	27	247.87	
Meaningfulness	1149.73	3	383.24	8.56**
I. Q. x Meaningfulness	2535.05	6	422.51	9.44**
Error 2	3627.54	81	44.78	

TABLE 4

A. Mean Response Latency to Criterion for Various Aspects of the Study (in seconds)

1. Overall effects of meaningfulness

Source	V	N
Trainable	38.90	40.59
Educable	15.66	40.01
Normal	10.28	33.24

2. Effects of meaningfulness where V and N are compared as stimulus

Source	V_1	N_1
All Ss	24.6	36.3

3. Effects of meaningfulness where V and N are compared as response items

Source	V_2	N_2
All Ss	28.1	32.8

4. Effects of meaningfulness as stimulus and response

Source	V_1	V_2
All Ss	24.6	28.1

B. Performance in generating labels for V and N items

Source	V	N
Trainable	21.5	10.8
Educable	23.6	14.9

TABLE 5

A. The Performance of Each Group of Ss on Various Aspects of the Study

1. Overall effects of meaningfulness

Source	t	p
Trainable	0.84	$p < .10$
Educable	4.30	$p < .01$
Normal	3.47	$p < .01$

2. Effects of Meaningfulness where V and N are compared as stimuli

Source	t	p
All Ss	14.25	$p < .01$

3. Effects of Meaningfulness where V and N are compared as response items

Source	t	p
All Ss	6.14	$p < .01$

4. Effects of Meaningfulness as stimulus and response

Source	t	p
All Ss	2.08	$p < .025$

B. Performance in generating labels for V and N items

Source	t	p
Trainable	13.72	$p < .01$
Educable	13.49	$p < .01$

TABLE 6

Mean Response Latency on Trial 1 and Trial 4 (in seconds)

Source	Trial 1	Trial 4
Trainable	50.73	28.74
Educable	24.12	10.25
Normal	11.88	6.85

TABLE 7

Performance of Ss on Trial 1 and Trial 4

Source	t	p
Trainable	3.37	$p < .01$
Educable	2.99	$p < .01$
Normal	2.49	$p < .05$

TABLE 8

Strength of Test (estimated ω^2)

Comparison	Trainables	Educables	Normals	All Ss
VV - NN	--	.467	.356	--
$V_1 - N_1$	--	--	--	.910
$V_2 - N_2$	--	--	--	.647
$V_1 - N_2$	--	--	--	.143
V - N labels	.823	.901	--	--
Trial 1 - Trial 4	.341	.284	.206	--

DISCUSSION

The outcomes of this study point to the conclusion that meaningfulness is a vital factor in learning, not only for normal Ss but also for the mentally retarded. Educable Ss were able to utilize the meaningfulness of both stimulus and response items. However, although trainable Ss were able to respond (with labels) more frequently to meaningful items, they were unable to utilize this information in the paired-associate task. Since all Ss did eventually reach criterion, it is reasonable to suggest that with a different training phase trainable Ss might be able to utilize meaningfulness more effectively. This study concurs with previous findings that mentally retarded Ss do perform at a higher level on meaningful items (Drew, 1968), for the specific case of educable mental retardates. This study also supports the findings of Baumeister and Berry (1956) that mentally retarded Ss are not able to utilize various dimensions of the stimulus, for the specific case of trainable mental retardates.

Although the three subject groups performed as expected, with normals more efficient in achieving the criterion than educables, and trainables performing least efficiently, a noticable difference was found in the pattern of utilization of meaningfulness in the stimulus and response items. The greatest absolute difference in performance on V items and N items appears for the educable group. This does not imply that these Ss surpassed the normals in utilization of meaningful clues,

but that normals were better able to analyze the nonmeaningful items. This might be an expected result for the normal Ss, since the items were necessarily designed to be utilized with educable and trainable Ss as well.

If meaningfulness was utilized in the solution of this paired-associate task, where was this factor most effective, as the stimulus or as the response item? Previous studies have established that meaningfulness has a greater effect in the response position of the standard paired-associate paradigm (Underwood and Schulz, 1960). This superiority has been attributed to the dual role of the response item as it functions in both response learning and the association phase of learning. However, when the need for response learning was minimized, as in the present study, meaningfulness has been found to have a greater effect in the stimulus role (Hopkins and Schulz, 1969). This effect was found for all Ss.

However, Baumeister and Berry (1956) concluded from their study that mentally retarded Ss were unable to utilize various dimensions of the stimulus items. This hypothesis raises some question as to the basis for the Ss' performance. Was the superiority of V items actually due to the utilization of meaningfulness of those items? The mentally retarded Ss were asked to label all items, both V and N. Without exception, all responded more appropriately and more frequently to the V items. Apparently meaningfulness was a recognizable concept, even to trainable Ss. The data indicate that, as expected, the educables utilized this information more effectively than did the trainables.

In spite of the abstract nature of the task, both normal and mentally retarded Ss exhibited learning across trials. The data indicated the greatest difference in performance for the trainables, with somewhat less difference for the educables, and still less (although still significant) difference for normals. This suggested an unequal base level of performance, allowing trainables a greater potential for improvement. Again, this reflected the design of the stimulus and response items.

Analysis of the strength of test, estimated ω^2, revealed a strong associative relationship for several phases of the study. The labelling of V and N items by both educable and trainable Ss showed a very high degree of association. Those Ss who were able to label N items with a fair degree of frequency were also those who responded with even greater frequency with labels for the V items. This information is of greatest value when considered from the opposing perspective: those Ss who most frequently generate labels for meaningful items will more readily generate labels for nonmeaningful items.

The superiority of meaningfulness as a stimulus and as a response item was found to be significant beyond the .01 level in each case. However V_1, meaningfulness as a stimulus, showed greater strength than did V_2, meaningfulness as a response item, $\omega^2 = .910$. This bears out the findings of Hopkins and Schulz (1969), who also used a paradigm designed to reduce the effect of response learning.

In order to examine the role of meaningfulness in an undiluted and less complex arrangement, combinations VV and NN were compared.

The difference found for trainables was not significant; those for educables and for normal Ss were significant beyond the .01 level. The distinct characteristics of the pairings isolated each factor, meaningfulness and nonmeaningfulness, and allowed examination of each without an intervening influence of the other. Here the strength of association was found to be less than those for mixed pairs. Evidently another factor (or factors) was involved in performance on these sets, and further investigation is warranted. For interests' sake, study was made of the combination $V_1 - N_2$, to determine the effectiveness of meaningfulness in the stimulus item as compared to nonmeaningfulness in the response item. Here again, meaningfulness was found to be significantly superior. There is apparently only minimal associative strength in this relationship.

The association between trials one and four was only moderate. All three groups exhibited significantly superior performance on the fourth trial, but a complex combination of factors contributed to the learning.

This complexity generates a challenge and a persistent fascination with the nature of the learning process. The present study has only touched on a minute phase of one aspect of a special situation of learning. From this point, further study is needed in defining and exploring the specific functions of meaningfulness, particularly for the special case of the trainable mentally retarded. Such studies should be specifically designed for this group. As was found in the course of this study, materials designed for use with trainables,

educables, and normals can at best suit the middle group and be extended with effort for use with the two extremes.

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APPENDIX

APPENDIX 1. Stimulus and Response Items

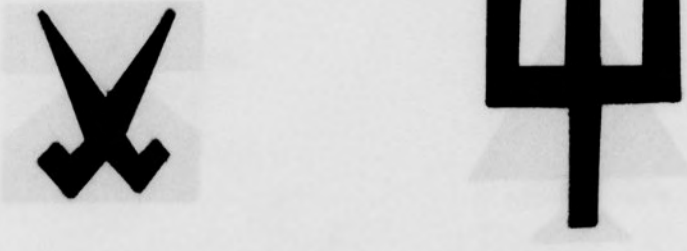
VV

S_1

S_2

VV

S_1



S_2

VV

S_1

S_2

VV

S_1

S_2

VV

S_1

S_2

VV

S_1

S_2

VN

S_1

S_2

VN

S_1

S_2

VN

S_1

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S_1

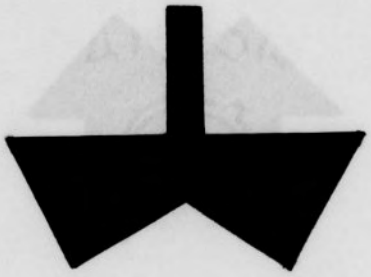
S_2

NV

S_1

S_2

NV



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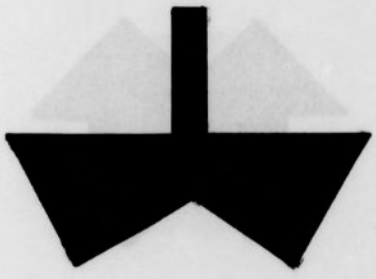


S_2

NV

S_1

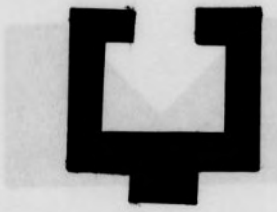
S_2

NV

S_1

S_2

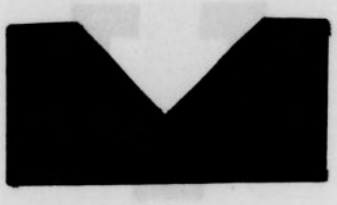
NV



S_1

S_2

NV



S_1

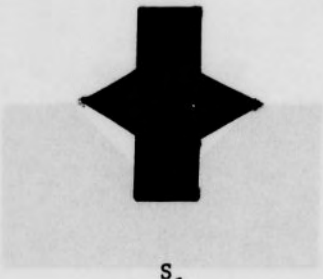
S_2

NN

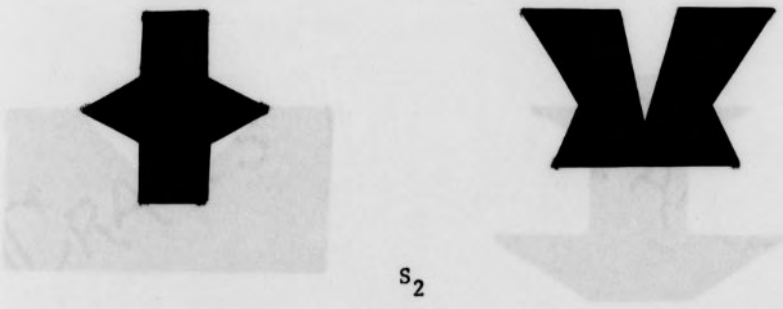
S_1

S_2

NN



S_1



S_2

NN

S_1

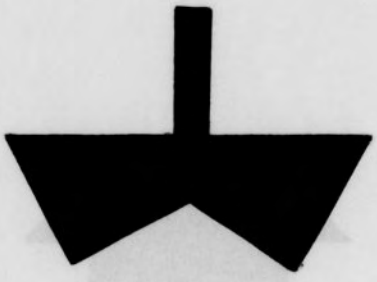
S_2

NN

S_1

S_2

NN



S_1

S_2

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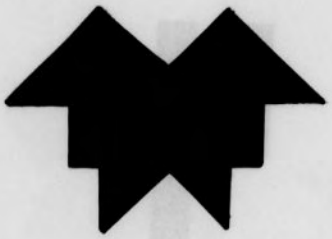
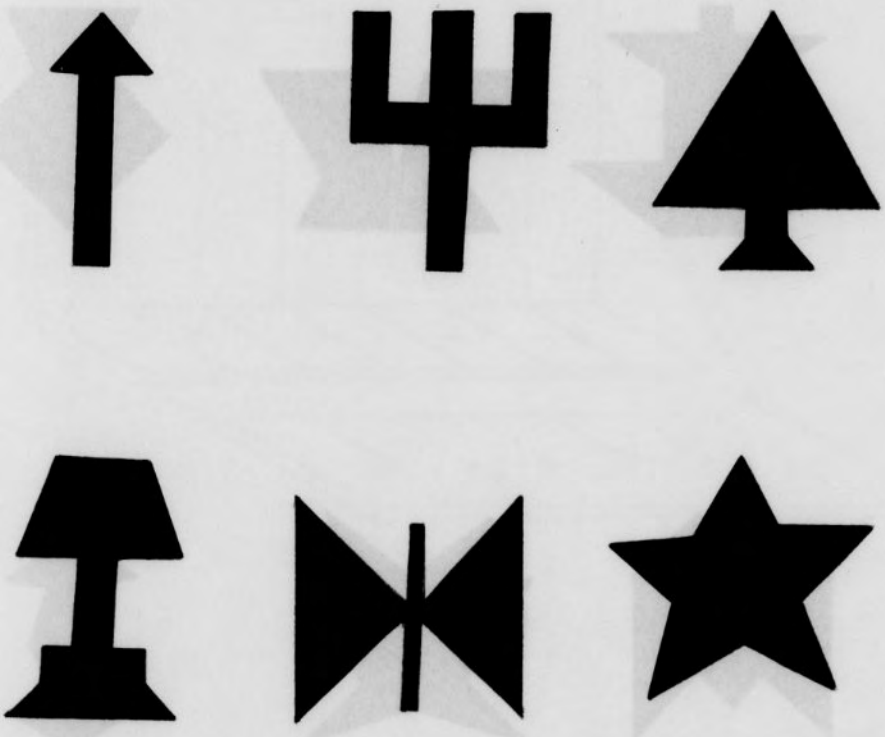


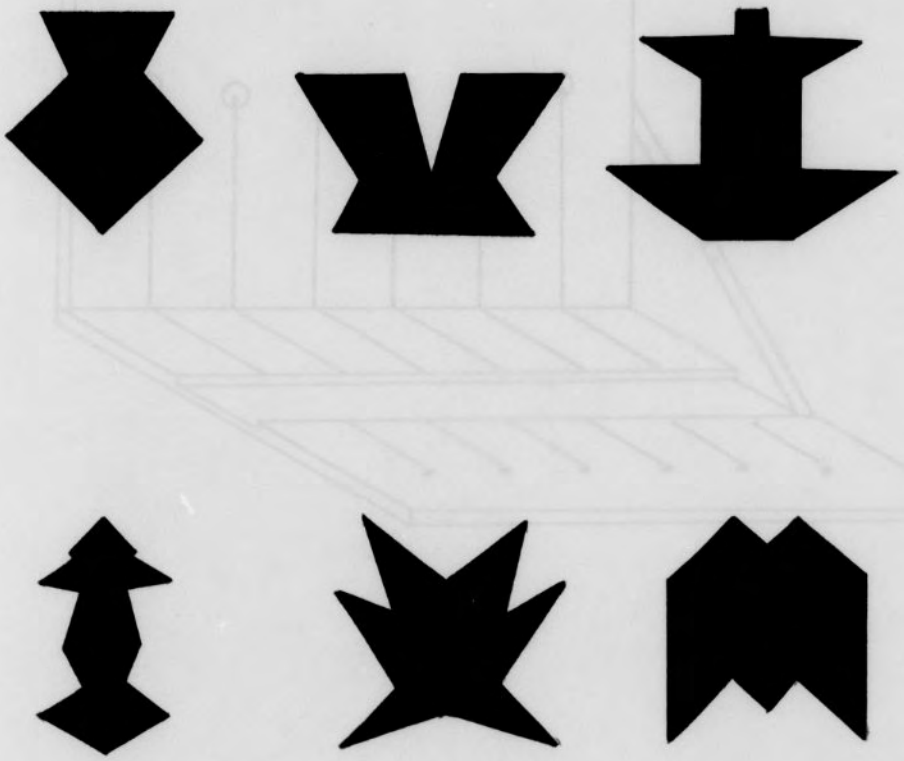
S_1

S_2

Items on Response Strip V



Items on Response Strip N



APPENDIX 2. Response Board