1963

Effects of Stimulus Meaningfulness on Star Discrimeter Performance

R. H. Peters
State University of Iowa

Let us know how access to this document benefits you

Effects of Stimulus Meaningfulness on Star Discrimeter Performance[1]

R. H. PETERS

Abstract. In a motor task provided by the Star Discrimeter, Ss learned to move a wobble stick into channels corresponding to six verbal stimuli. Two levels of stimulus meaningfulness (M) were used. The stimuli for the high M group were words, and the stimuli for the low M group were paralogs. Prior to motor task learning, 30 of the 60 Ss in each M group received relevant stimulus familiarization training. The S pronounced each dissyllable 20 times. The remaining Ss received irrelevant familiarization training. The S pronounced the name of six common shapes 20 times each. The results indicated that both stimulus M and familiarization are directly related to rate of learning on the Star Discrimeter.

Numerous studies have investigated the effects of variations in stimulus meaningfulness (M) on verbal paired-associate performance (Cason, 1933; Sheffield, 1946; Kimble and Dufort, 1955; Mandler and Campbell, 1957; Cieutat, Stockwell and Noble, 1958; L'Abate, 1958; Weiss, 1958; Hunt, 1959). The majority of these has demonstrated that stimulus M is directly related to rate of learning. The magnitude of the obtained differences were generally small and occasionally not significant. The consistent results of these experiments, however, indicate that the effect of stimulus M on the learning of verbal paired associates, although small, is real.

Stimulus familiarization has been found to have either no effect or, perhaps, even a slight inhibitory effect on the learning of verbal paired associates (Sheffield, 1946; Weiss, 1958; Underwood and Schulz, 1960; Cieutat, 1961). The positive results obtained by Gannon and Noble (1961) have been attributed to the articulation procedure used in their experiment (Schulz and Tucker, 1962), rather than to any positive effect intrinsic to stimulus familiarization.

In direct contrast, the majority of studies mentioned above have also demonstrated that both response M and familiarization are directly related to rate of learning of verbal paired associates. The obtained differences were large and statistically significant.

The purpose of the present investigation was to determine the relative effects of variations in stimulus M on the perform-

---

415

ance of a perceptual-motor task. The task was provided by the Star Discrimeter.

The "Star" task has certain conceptual similarities to the traditional verbal paired-associate learning paradigm. A different response is learned to each of six stimuli. The particular response associated with each stimulus, however, does not contain an explicit verbal component. Rather, each response consists of a movement of a wobble stock into one of six response channels. These motor responses are easily made and do not require skilled manipulative movements. Response learning is minimal.

Two operational definitions of M were used in the experiment. The first consists of the procedures used by Noble (1952) in obtaining scaled values of M for 96 dissyllables. The second is based on the position taken by Underwood and Schulz (1960) that the M of a given verbal unit is a function of S's prior frequency of experience with that unit. Familiarization procedures were used in an attempt to manipulate the M of the stimulus materials.

APPARATUS AND PROCEDURE

The Star Discrimeter, described in detail by Cantor (1955), has a response unit with six channels radiating symmetrically from a center opening in a horizontal steel plate. A wobble stick protrudes from this opening and may be moved freely into any one of the six channels. The stimulus unit contains a circular piece of opal flash glass onto which six different stimuli can be projected. A 50-point stepping switch is used to present a continuous random sequence of the six stimuli.

The task is to learn which of the six stimuli is associated with each channel. When a stimulus is presented, S responds by moving the wobble stock into one of the channels. It the response is correct, the stimulus changes. If the response is incorrect, the stimulus remains unchanged and S continues responding until the correct response is made.

Thirty trials were given on the Star Discrimeter. Each trial was 20 sec. long with 10 sec. inter-trial intervals. The number of correct responses and the number of errors were recorded for each trial.

The familiarization training was given in the same room as motor task training. The S sat on a chair facing a translucent screen approximately 4 ft. distant and slightly above eye level. The stimuli were presented by a Perceptoscope[1] 16 mm. film strip projector equipped with a 300 W. projection lamp. The Perceptoscope was mounted behind the screen. The task was to

[1] Model 5102-2 manufactured by the Perceptual Development Lab., St. Louis, Mo.

pronounce or name each stimulus when it was projected on the screen. Each stimulus was projected for 1 sec. followed by another 1-sec. interval when the screen was blank. S, thus, had slightly less than 2 sec. to make each response.

Subjects

The Ss were 60 male and 60 female volunteers from the introductory psychology course at the State University of Iowa. All Ss received the equivalent of two examination points toward their final grade for their participation. Four Ss were discarded because of apparatus failure. The Ss were randomly assigned to each of the four groups with the restriction that each group contain an equal number of men and women.

Experimental Design

The stimulus materials used in the Star Discrimeter for the motor task were dissyllables scaled for M by Noble (1952). Two levels of M were used. The stimuli for the high M (HM) group were six words (JELLY, MONEY, QUOTA, UNCLE, WAGON, and ZEBA), while the stimuli for the low M (LM) group were six paralogs (BALAP, GOJEY, KUPOD, LATUK, POLEF, and TAROP). All of the dissyllables contained five letters. The initial letter of each stimulus was never repeated in that position. The mean M values of the stimuli for the HM and LM groups were 7.20 and 1.26, respectively.

Prior to the learning of the Star Discrimeter task, 30 of the 60 Ss in each of the two groups received relevant stimulus familiarization training. Each stimulus subsequently used on the motor task for the HM and LM groups was pronounced 20 times by S. Five random orders of stimulus presentation were used.

The remaining 30 Ss in each group received irrelevant familiarization training. The task was to pronounce the name of each of six common shapes (Oval, Rectangle, Square, Diamond, Circle, Triangle). The name of each shape was pronounced 20 times. None of these stimuli was used on the motor task.

Conceptually, all Ss received either 0 or 20 trials of relevant stimulus familiarization training. A trial was defined as one presentation of each of the six stimuli. The irrelevant familiarization procedure was used to control for such non-specific transfer effects as learning-how-to-learn and warm-up.

An additional variable, sex, was included in the design. This was necessitated by the limitations of the S population at the time the experiment was run. Each of the four treatment combination groups was comprised of 15 male and 15 female Ss. There was no *a priori* interest in any possible sex differences.

Results

The correct response and the error data were analyzed ac-

cording to Lindquist's (1956) Type III design modified by the inclusion of a third "between" factor[2]. The three factors were level of stimulus M (M), type of familiarization training (R), and sex (S). The "within" factor was trials. The summaries are shown in Tables 1 and 2. A 5% Coefficient of risk was adopted for all statistical analyses.

Table 1. Summary of the analysis of variance of correct responses over the 15 blocks of motor trials

Source	df	SS	MS	F
Total between	119	8926.71		
Relevancy (R)	1	339.31	339.31	*4.85
Meaningfulness (M)	1	550.57	550.57	*7.87
Sex (S)	1	125.62	125.62	1.80
R x M	1	4.95	4.95	0.07
R x S	1	3.40	3.40	0.05
M x S	1	43.39	43.39	0.62
R x M x S	1	25.10	25.10	0.36
error (b)	112	7834.37	69.95	
Total within	1680	17960.27		
Trials (T)	14	13864.85	990.35	*413.86
T x R	14	100.52	7.18	*3.00
T x M	14	106.84	7.63	*3.19
T x S	14	36.89	2.64	1.10
T x R x M	14	12.49	0.89	0.37
T x R x S	14	23.42	1.67	0.70
T x M x S	14	49.64	3.55	1.48
T x R x M x S	14	13.45	0.96	0.04
error (W)	1568	3752.17	2.39	
Total	1799	26886.98		

* $p < .05$

Table 2. Summary of the analysis of variance of errors over the first 15 motor trials

Source	df	SS	MS	F
Total between	119	14075.99		
Relevancy (R)	1	200.67	200.67	1.84
Meaningfulness (M)	1	1053.41	1053.41	*9.66
Sex (S)	1	347.61	347.61	3.19
R x M	1	59.40	59.40	0.54
R x S	1	139.44	139.44	1.28
M x S	1	51.00	51.00	0.47
R x M x S	1	7.61	7.61	0.07
error (b)	112	12216.86	109.08	
Total within	1680	13109.25		
Trials (T)	14	5087.77	363.41	*76.63
T x R	14	74.18	5.30	1.11
T x M	14	136.97	9.78	*2.06
T x S	14	224.87	16.06	*3.39
T x R x M	14	48.60	3.47	0.73
T x R x S	14	65.13	4.65	0.98
T x M x S	14	14.10	1.01	0.21
T x R x M x S	14	21.37	1.53	0.32
error (w)	1568	7436.25	4.74	
Total	1799	27185.25		

* $p < .05$

---

[2] The data were processed on an IBM 7070 computer. The program for this analysis was written by Professor C. C. Spiker.

The analysis of the error data included only the first 15 trials on the motor task. It was felt that the number of "O" scores (no errors) obtained on the last 15 trials would violate the assumption of normally distributed criterion measures underlying the F-test of the null hypothesis. The correct response data were analyzed over blocks of two trials.
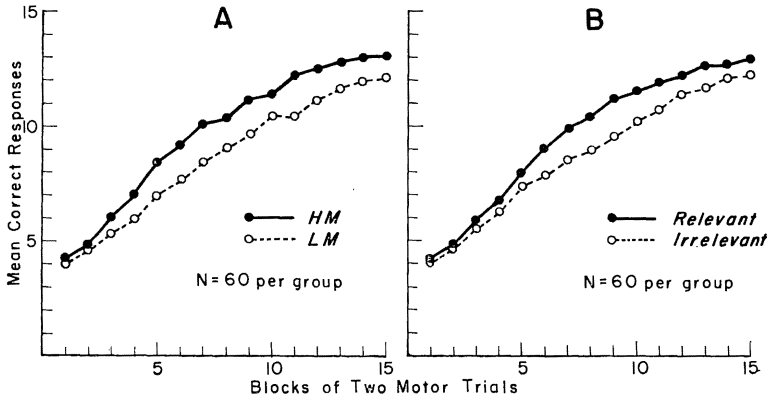

Figure 1.   Means of correct responses over blocks of two trials on the Star Discrimeter for the conditions of Meaningfulness (A) and Relevancy (B).

Figure 1A presents the means of correct responses over blocks of two trials for the HM and LM groups. The general means for the HM and LM groups were 9.71 and 8.60, respectively. The main effect of stimulus M and the M x T interaction were significant. The hypothesis of no difference between HM and LM means can be rejected. The HM groups performed generally at a higher level than did the LM groups.

The trend lines for the means of correct responses over blocks of two trials for the relevant and irrelevant groups are depicted in Figure 1B. The F values associated with both the relevancy and the R x T effects were significant. Relevant stimulus familiarization training resulted in superior motor performance. The general means were 9.59 and 8.72 for the relevant and irrelevant groups, respectively.

Means of errors for the HM and LM groups are plotted against trials in Figure 2A. The results were essentially identical to those obtained with the correct response measure. The main effect of variations in stimulus M and the M x T interaction were significant. The superiority of the HM group's performance was, therefore, also reflected by the error data.

Figure 2B presents the means of errors plotted against trials for the relevant and irrelevant stimulus familiarization groups. The relevant groups performed generally at a higher level than did the irrelevant groups. Both the relevancy and the R x T
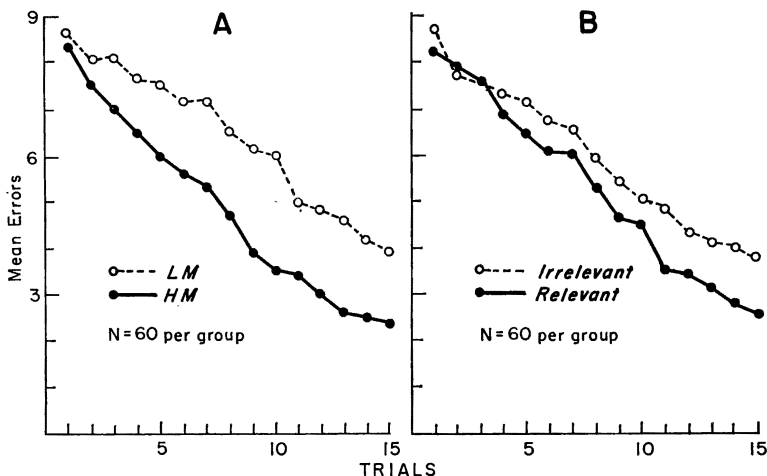
Figure 2. Means of errors over the first 15 trials on the Star Discrimeter for the conditions of Meaningfulness (A) and Relevancy (B).

effects, however, failed to reach the prescribed level of significance. This indicates the hypothesis that the trend lines shown in Figure 2B are coincident cannot be rejected.

A significant S x T interaction was found in the analysis of the error data. As stated previously, there was no *a priori* interest in the sex variable. Furthermore, since the sex variable did not interact with any other experimental conditions, no attemp was made to interpret the significant interaction with trials. None of the other comparisons summarized in Tables 1 and 2, with the exception of trials, was significant.

DISCUSSION

The data on Star Discrimeter performance indicate that increases in stimulus M will facilitate motor task learning. As seen in Figure 1A and 2A, the HM groups made more correct responses and fewer errors than the LM groups. In contrast to most results obtained in verbal paired-associate learning studies, the differences were large and significant.

There are several possible factors which could account for this facilitation. Stimulus M may influence the rate at which associations are formed. This interpretation has been used to account for the small effects of stimulus M when verbal materials have been used as both stimuli and responses. The large significant differences found in the present experiment may simply result from a greater influence of stimulus M on the associative stage when the responses consist of motor movements. There is, however, no apparent reason why this should be true. The following explanation would seem to be more plausible.

During the experiment, E noticed several Ss were pronouncing the stimuli as they responded, although they had not been instructed to do so. When questioned, these Ss indicated they had labeled each response channel with the name of the appropriate stimulus. Additional Ss also indicated they had used this method to master the task, although they had not overtly pronounced the stimuli.

In effect, the stimuli may have also provided additional cues for the Ss as an aid to their differentiation among the six motor responses. McAllister (1953) has demonstrated that facilitation of Star Discrimeter performance results when the responses of a paired-associate pre-training task are relevant to the responses required to the same stimuli on the subsequent Star task. Furthermore, the amount of facilitation was found to be a function of the kind of response words used in pre-training. The highest level of motor performance resulted when the pre-training responses were directions analogous to the directions required for the movement of the wobble stick. Pre-training responses which provided for a clock analogue produced greater facilitation than a degree analogue, although less facilitation than the direction analogue.

McAllister concluded that the obtained differences were due to the differential M or familiarity of the analogues to the Ss. Similar reasoning can be used to explain the results of the present study. The HM words may have been easier to attach to the response channels than were the LM paralogs. Another possibility is the extent of generalization among the stimuli within each set. The HM words may have added more distinctiveness to the motor movements than did the LM paralogs. This interpretation, in conjunction with the probable effects of stimulus M on the rate at which associations are formed, would account for the large significant differences found in the present experiment.

The relevant stimulus familiarization groups made significantly more correct responses on the motor task. An inspection of Figure 2B also indicates the relevant groups made fewer errors. This latter difference, however, was not statistically dependable.

The interpretation of these results is consistent with the interpretation proposed for the M effects. Relevant stimulus familiarization training may have made the stimuli more readily available to the Ss for use as additional labeling cues for the motor responses. The Ss receiving irrelevant familiarization training had never seen the stimuli in this situation until they were used on the motor task.

422   IOWA ACADEMY OF SCIENCE   [Vol. 70

Literature Cited

Cantor, J. H., 1955. *J. exp. Psychol.*, 50, 180-184.

Cason, R., 1933. *J. exp. Psychol.*, 16, 295-305.

Cieutat, V. J., 1961. *Percept. mot. Skills*, 11, 269-275.

Cieutat, V. J., Stockwell, F. E., & Noble, C. F., 1958. *J. exp. Psychol.*, 56, 193-202.

Gannon, D. R., & Noble, C. E., 1961. *J. exp. Psychol.*, 62, 14-23.

Hunt, R. G., 1959. *J. exp. Psychol.*, 57, 262-267.

Kimble, G. A., & Dufort, R. H., 1955. *J. exp. Psychol.*, 50, 361-368.

L'Abate, L., 1959. *Amer. J. Psychol.*, 72, 107-110.

Lindquist, E. F., 1956. *Design and analysis of experiments in psychology and education*. Boston: Houghton-Mifflin.

Mandler, G., & Campbell, E. H., 1957. *J. exp. Psychol.*, 54, 269-273.

McAllister, D. E., 1953. *J. exp. Psychol.*, 46, 329-336.

Noble, C. E., 1952. *Psychol. Rev.*, 59, 421-430.

Schulz, R. W., & Tucker, I. F., 1962. *J. exp. Psychol.*, 64, 449-450.

Sheffield, F. D., 1946. Unpublished Ph.D. dissertation, Yale Univer.

Underwood, B. J., & Schulz, R. W., 1960. *Meaningfulness and verbal learning*. Chicago: Lippincott.

Weiss, R. L., 1958. Unpublished Ph.D. dissertation, Univer. Buffalo.