Perceptual search time as influenced by association value: Stimulus discriminability or stimulus retention?*

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A horizontal search task was used to investigate the effects of association value (AV) and target retention on perceptual search times. Forty-eight Ss were required to locate a target trigram in a line of 10 field trigrams under the four possible combinations of high and low AV for target and field items. Each of these combinations appeared under conditions of forced target study or no forced target study prior to the search. Controls were provided for letter-search or partial recognition techniques, and random orders were used for equal distribution of practice effects over the blocks of 10 positions of the target. The results indicate that AV has only the effect of facilitating retention of target items and, therefore, has no direct influence on perceptual search times.

Conflicting results have been found when the effects of association value (AV) on perceptual search times have been investigated. Studies by Portnoy, Portnoy, & Salzinger (1964) and Schulz & Lovelace (1964) indicated that as AV changed, the discriminability of a target trigram in a field of trigrams was changed. Smith & Egeth (1966) criticized the previous studies on methodological grounds and failed to replicate the findings in a new design. In a later study, Davidson & Robertson (1970) suggested that practice effects had influenced the findings of Smith & Egeth (1966). In a design to control practice effects, Davidson & Robertson (1970) obtained data which supported the stimulus discriminability hypothesis; however, in their discussion of the data, they suggested that the results could have been produced by differential retention of the high- and low-AV targets.

It was suggested by Davidson & Robertson (1970) that since target trigrams of low AV would have been assimilated and/or retained to a lesser degree than target trigrams of high AV (Peterson & Peterson, 1959; Underwood, 1964), the additional time required to locate the target of low AV may have been due to the reassimilation of the target during the search. They further suggested that, when the target and field trigrams were of the same AV, there would be more interference of the field list with the retention of the target trigram than when the target and field trigrams were of different AV values. This would be expected because, as Smith & Egeth (1966) point out, the trigrams of the two AV values were somewhat different. The additional interference would be expected to force the reassimilation of the target in a field of the same AV and result in the consumption of more time.

This study was designed as a replication of the Davidson & Robertson (1970) study and as a test of the hypothesis that the differences in perceptual search times were produced by stimulus retention rather than stimulus discriminability. It was hypothesized that when there was forced assimilation (forced study) of the target prior to the search, then the results previously attributed to AV would be changed and, therefore, shown to be a function of stimulus retention.

SUBJECTS

Forty-eight beginning psychology students of both sexes at Oklahoma City University were used as Ss.

APPARATUS

The target and field trigrams were presented through the aperture of a Lafayette memory drum (Model 2303B3). The target was presented at the left end of the aperture and was separated from the field list of 10 items including the target by a strip of black tape (1/8 in. wide) on the front of the apparatus. In one condition (FS), the target was allowed to appear as soon as the memory drum turned, which was 3 sec before the shutter lowered to reveal the field of trigrams. In another condition (NFS), a cardboard extension was placed on the shutter so that the target and field were exposed at the same time. The numerals from 1 through 10 were affixed below the aperture so that each of the 10 trigrams in the field list corresponded to a numeral. When S located the target, he called out the position by referring to the numeral directly below it.

When the shutter of the memory drum lowered so that the list of trigrams was exposed, a Hayden stop clock (callibrated in 1/100ths of seconds) was started. When S called out the position of the target, a voice reaction apparatus (Lafayette Model 6602A) was pulsed via a throat microphone and the clock was stopped. The stimuli were presented at 20-sec intervals, and 1 sec before the next list was presented the stop clock was automatically reset.

DESIGN

Stimulus lists were prepared of 10 target and 90 field trigrams of 100% AV and 10 target and 90 field items of 0%-7% AV, according to Glaze's (1928) tabulation. The 90 field items of each AV level were arranged in 10 horizontal rows of 9 items per row. The 10 target items were inserted into the 10 rows of field items so that each row (one trial) consisted of 9 field items and 1 target item. The rows were constructed with high formal intraline similarity to the target item, with particular emphasis on repeating the first letter of the syllable once to control for partial recognition search strategies. The positions of the targets in the field rows were randomly determined, with the condition that no target position was duplicated in each block of 10 rows. In this manner, 40 rows were created (10 rows for each target-field AV combination). In order to balance any possible order effects further, the 10 rows of each of the four blocks were arranged in three random orders. The 10 rows of one block were sequentially exposed to a single S. This produced 10 target search trials for each S. It was thought that with the targets randomly inserted into the rows and the rows arranged into three random orders, all order effects would be balanced.

The study was run in a 2 by 2 by 2 by 10 design, with study (FS) and no study (NFS), high (HT) and low (LT) target AV, high (HF) and low (LF) field AV, and 10 positions of the target in the field. Each of eight independent groups of six Ss experienced only one study condition, one target AV, and one field AV, but each S did 10 trials and therefore experienced all 10 positions of the target within the field. Ss were assigned to the eight groups and three orders of each list by block randomization.

PROCEDURE

The Ss were given verbal instructions, and when they reported that the instructions were understood, the experiment was begun with no practice trials. As the clock stopped with each response, E recorded the

*The data for this study was collected while both authors were at Oklahoma City University.

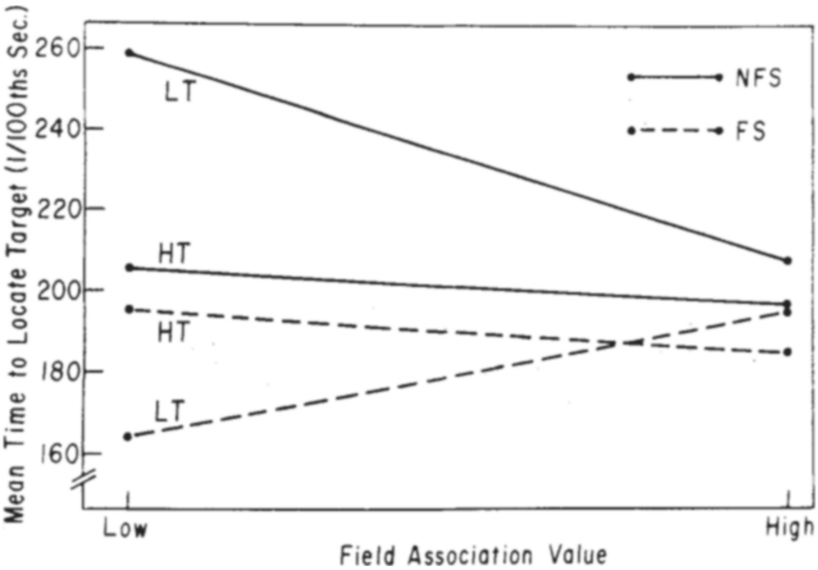

Fig. 1. Perceptual search times as a function of field AV, target AV, and amount of prior study of the target.

response latency as well as the response given by S.

RESULTS

The response measure was the time, in 1/100ths of seconds, required by S to locate the target. Due to extraneous noises made by Ss before responding and occasional incorrect responses, 31 of the possible 480 scores were missed. No more than two scores were missed by any one S. In order to avoid the problem of unequal cell sizes, the 10 positions were collapsed into five blocks of two positions, with the mean of the block of two positions used as the score in the analysis of variance. This changed the 2 by 2 by 2 by 10 design to 2 by 2 by 2 by 5, with only the position variable as a within-S effect. In the collapsed design, all cells contained an equal number of scores.

An analysis of variance in a split-plot design (three between-S varaibles and one within-S variable), as outlined by Kirk (1968), was performed on the data.

It was found that the study factor produced a main effect [$F(1,40) = 5.20$, $p < .05$] and that the position of the target in the field list produced a main effect [$F(4,160) = 5.80$, $p < .005$]. Neither the target nor the field AV produced a main effect. A three-way interaction between study conditions and target AV and field AV [$F(1,40) = 4.50$, $p < .05$] was found. No other effects were significant.

The interaction effects are shown in Fig. 1. It will be noted that the interaction found by Davidson & Robertson (1970) is generally replicated in NFS, although the curves do not quite intersect in the range presented here. In FS, this interaction is reversed, which produced the three-way interaction between study, target AV, and field AV.

DISCUSSION

The data, especially the reversal of the target AV/field AV relationship in FS and NFS, indicate that the effects previously thought to be directly due to association value are only indirectly related through differential retention of the targets. The suggested effect of interference is given additional support in the reversal of the low-AV target in the low-AV field when study is forced. When study is not forced, then there is apparently a retention loss due to incomplete assimilation. However, as Smith & Egeth (1966) point out, these low-AV materials have less intralist similarity than do high-AV materials, and, therefore, when assimilation is forced, there is less interference during the search and the search occurs more rapidly.

In conclusion, it seems that AVs of targets and fields in perceptual search have only the effect of influencing assimilation and/or retention of the target items, not the discriminability of those items. This influence may be enhanced by the differing materials used in high and low AV which causes differing amounts of interference with the retention of the target items.

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