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AUTHOR Brown, Alan S.; Cattoi, Robert
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ABSTRACT

A study examined the effect of variation in category dominance on retrieval latencies (and errors) from semantic memory. Subjects, 66 students enrolled in an introductory psychology course, were required to perform 6 successive retrievals from each of 18 conceptual categories. The six retrievals consisted of two successive blocks of three from either high, medium, or low dominance tasks. Increasing retrieval latencies and increasing number of errors indicated that the build-up of inhibition across position was more immediate for the low-dominance than for the high-dominance items. These results support the position that the number of prior retrievals from the same conceptual category is the primary determiner of the incrementing of retrieval inhibition. Effort-induced slowdo n of retrieval did not occur. These results suggest that two opposing processes occur in category access: a general initial facilitation and a cumulating inhibition. The cumulating inhibition is directly related to the number of prior retrievals, both explicit and implicit. (JL)

Associative Strength Effects in Semantic Priming

Alan S. Brown and Robert Cattoi

Southern Methodist University

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Associative Strength Effects in Semantic Priming

The format in which items are stored and accessed from semantic memory conceptual categories motivated a series of investigations by Loftus (1973; Loftus & Loftus, 1974; Loftus, Senders, & Terkeltaub, 1974) in which she presented category-letter primes (e.g., animal—G) and timed the latencies to retrieve an appropriate exemplar. The second instance from the same category was consistently retrieved more rapidly than the first. Furthermore, there was a systematic increase in the retrieval latency of the second item as the number of intervening retrievals (from other categories) increased from 0 to 1 to 2. This set of investigations gave important support to the notion that semantic memory consists of a series of interconnected nodes which can energize each other when activated, with the degree of activation dissipating rapidly with time (cf. Collins & Loftus, 1975).

A recent investigation (Brown, 1981), however, brings the generality of the earlier findings into question. Brown had subjects retrieve either five (Exp. 1) or eight (Exp. 2, 3, and 4) exemplars from a specific semantic category and discovered that retrieval times <u>increased</u> rather than decreased across successive retrievals. Brown suggested that two different processes may occur during category retrieval: general category activation, which facilitates retrieval, and compounding inhibition, which occurs with each successive retrieval effort. The facilitory process (or category "warm up") takes place over several seconds, while the incrementing inhibition is item dependent.

Brown apparently reduced the magnitude of the initial category incrementation by fully informing the subjects concerning the nature of the successive retrievals and presenting the category label prior to the block of items from that category. Loftus and Loftus (1974) did give the category name to their subjects for 2.5 seconds prior to the critical letter in one condition, and this did not eliminate facilitation on the successive retrieval from the same category, although it did reduce its magnitude. This short time span, however, may not have been adequate for the facilitatory effect to fully evolve.

Brown also speculated that the total number of retrieval efforts, whether they be explicit (correct word generated and output) or implicit (incorrect word generated and rejected) was critical. A logical extension of this is that the more specific the cue, the less likely are extraneous (implicit) retrievals and the less rapid will be the build-up of inhabition. Support for this speculation was derived from a comparison of retrievals using a category-letter cue versus a picture cue. Since the category-letter is less specific, and is therefore succeptible to more implicit retrieval attempts, it should show a more rapid increase in inhibition than with the picture cue. This was, in fact, what was found.

This account, however, was post hoc and needs a direct test. To accomplish this, variations in categorical association were examined using the category-letter paradigm. It is assumed that members with high associative strength (animal—D) would be less likely to result in retrieval of extraneous exemplars whereas those which are less frequent (animal—P) would. The result should be an interaction of the pattern of interference buildup over position with the frequency of the exemplars. Interferance should acrue more rapidly with a succession of low frequency exemplars than with a series of high frequency members.

Method

Subjects. A total of 66 students in introductory psychology courses at Southern Methodist University served in the investigation. Participation was on a voluntary basis, with extra course credit being given as an incentive.

Design and Materials. Eighteen conceptual categories were selected from the Battig and Montague (1969) norms. For each category, the nine most frequent members were selected. If they did not each begin with a different first letter, then additional exemplars were selected (in decreasing strength order) until nine different letters were available. Within this set, the first three letters were designated high frequency (H) members, the last three low frequency, (L) and the middle three medium frequency (M).

The 18 categories were randomly arranged into a sequence which remained fixed for all subjects. Each subject retrieved six different cues in succession from each of the 18 categories. The six retrievals were broken down into two sets of three members each. Each block of three members was either all H, all M, or all M, and were retrieved in succession. This resulted in six possible combinations of two frequency levels (HM, HL, MH, ML, LH, or LM) for any given category. The six different combinations of frequency level pairings were balanced within a list so that each subject received three categories representing each combination. In addition, the frequency level pairing occurred an equal number of times with each category across subjects, necessitating the construction of six different forms of the presentation sequence.

Procedure. Each subject was run individually, and was assigned to a form on a block randomized basis as they showed up for the study. That is, with each successive six subjects one was assigned to each of the different forms. Prior to their participation, the subjects were fully informed concerning the procedure and were given two practice categories, with six exemplars each. The subjects' response times from the presentation of the cue slide to the intitiation of their response were recorded to the nearest 100th sec. by a Lafayette voice activated relay. If 15 sec. elapsed without a response, the experimenter terminated that trial and proceded to the next item.

The stimulus slides consisted of the category name on the left with the appropriate letter on the right. Prior to each category, the category name alone was shown for 2.5 seconds. In addition, a change in category was indicated by a blank slide, shown for 2.5 seconds. Within the block of three items from a specific frequency level, the items were randomly arranged. This random arrangement remained the same whenever that set of three items occurred. There was no indication in instructions or procedure of the shift in frequency level in the middle of the category.

Results

Prior to the analysis, the median response time for each position in each of the six frequency pair conditions was computed. This resulted in

36 times for each subject. General reaction time changes over position were examined first. As shown in Figure 1, the latencies increased across

Insert Figure 1 about here

position. Because of the positive skew in the latency distribution,a log transformation was applied to the data prior to analysis. The analysis of variance revealed a significant difference among positions, $F(5,325) = 3.54$.[1]. Trend tests were also applied to the data, resulting in a significant linear trend, $F(1,325) = 4.09$, but no significant quadratic trend, $F(1,325) < 1$. The mean number of errors is also presented in Figure 1, with an error being defined as an inability of the subject to generate an appropriate exemplar within the 30 sec time limit. This data plot also suggests a general increase in errors across positions, with a slight decline over the first few positions. An analysis of variance indicated a significant overall difference among positions, $F(5,325) = 8.73$, and the trend analysis detected a significant linear $F(1,325) = 26.49$, and quadratic trend, $F(1,325) = 7.52$. Apparently there is both a general increase as well as an initial decline in the error data.

Of greater theoretical interest is the latency trends across positions for each of the three different frequency levels. This is shown in Figure 2. Due to the procedural discontinuity between positions 3 and 4, the data

Insert Figure 2 about here

will be analyzed separately for each half of the sequence. In positions 1 through 3, the data is not contaminated by the subcondition differentiation. However, in positions 4 through 6 each frequency level had a different exposure history of immediately preceding items. That is, the high frequency items had lower preceding items than the low frequency items, and vice versa. Because of this counfound, and the importance of the frequency manipulation within this design, more emphasis will be placed on the first three positions.

An analysis of variance on the first three positions yielded significant main effects for position, $\underline{F}(2,130) = 3.84$, and frequency, $\underline{F}(2,130) = 82.10$, as well as the interaction of position and frequency, $\underline{F}(4,260) = 4.10$. The main effects reflect an increase in latency with increasing position and decreasing frequency. For the interaction, this difference in the retrieval time changes across position for the frequency levels is congruent with theoretical expectations. Specifically, the slope of the latencies increases most rapidly for the low frequency items and least rapidly for the high frequency items. The error data, in Figure 3, support this differentiation. The increase in number of errors is more immediate for the low than high frequency items. As with the latency data, the main effects for position, $\underline{F}(2,130) = 3.23$, and frequency, $\underline{F}(2,130) = 44.32$, were both significant. However, the interaction of position and frequency fell short of significance, $\underline{F}(4,260) = 2.34$, $\underline{p} = .056$. Therefore, although the data trend mirrored that found with the latencies, the interaction was not statistically significant.

The last three positions were also analyzed with an analysis of variance. For this analysis, a third variable was added: frequency level (higher versus lower) of the preceding three retrievals. Higher and lower were relative to each other.

For the high frequency retrieval, preceding M items would be classed as higher and preceding L items would be classed as lower. For the low frequency retrieval, preceding H items would be higher and M items would be lower. Finally, for the medium items, H would be higher and L would be lower. Under the theoretical position proposed earlier, it is expected that lower preceding items would cause more inhibition than higher, resulting in a higher mean latency under the lower condition.

An analysis of the latency data revealed a significant main effect for frequency level, $\underline{F}(2,130) = 39.24$, and prior frequency level, $\underline{F}(2,130) = 3.32$. There was no significant main effect of position, $\underline{F}(1,65) = 2,82$, or interaction of frequency with position, $\underline{F}(2,130) = 1.01$, frequency with prior frequency, $\underline{F}(4,260) = 2.21$, prior frequency with position, $\underline{F}(2,130) = 2.49$, or frequency by prior frequency by position $\underline{F}(4,260) < 1$. The analysis confirmed the prediction, with a significant difference between the higher ($\overline{X} = 1.21$ sec) and the lower ($\overline{X} = 1.40$ sec) prior items.

The error data was also analyzed in a similar manner for the last three positions. This indicated significant main effects for frequency, $\underline{F}(2,130) = 56.40$, and position, $\underline{F}(2,130) = 12.60$, but not for prior frequency, $\underline{F}(1,65) = 1.72$. The interaction of frequency and position was significant, $\underline{F}(4,260) = 4.61$. However, the remaining interactions of frequency by prior frequency, $\underline{F}(2,130) = 2.02$, prior frequency by position, $\underline{F}(2,130) < 1$, and frequency by prior frequency by position, $\underline{F}(4,260) < 1$, were not significant. Although the mean number of errors for higher prior items (.498) was less than for lower items (.566), the difference was not statistically significant.

Discussion

The outcome of this investigation supports the position that the number of prior retrievals from the same conceptual category is the primary determiner of the incrementing of retrieval inhibition (Brown, 1981). Coupled with the facilitatory effects of category access afforded by the initial retrieval(s), this gives rise to a sharper increase in the inhibition with low frequency items than with high frequency items. The crucial assumption with this model is that subjects make more implicit (or incorrect) retrievals when searching for low-frequency exemplars than with high ones, thus incrementing the inhibition at a more rapid rate.

Support for this speculation comes from the difference in the slope among the three frequency levels for retrieval latencies across the first three positions. The high frequency items decrease and then level out, the medium frequency items decrease and then increase, and the low items increase and then decrease. The error data follows a similar pattern, although the interaction was not statistically significant. Additional support comes from the effect of prior retrievals on the succeeding ones. Higher frequency prior retrievals result in faster retrieval times for the succeeding retrievals. This pattern of results occurred for both latencies and errors, although it was significant only for latencies. This latter outcome, alone, does not provide strong support for the incrementing inhibition position. A spreading activation view (Collins & Loftus, 1975; Posner

& Snyder, 1975) also predicts that high frequency exemplars would result in a higher residual activation leval because their distance is not as far from the subsequently retrieved items. However, the spreading activation position cannot account for the difference among the frequency levels in the retrieval slopes over the first three positions.

Another interpretation of the data maybe that the buildup of inhibition is due to more "effort" being expended on the low frequency items. That is, because they are more difficult to locate and access, perhaps there is more of an accrual of retrieval exhaustion, or reactive inhibition, for these items which both slows later retrievals and increases non-successful efforts. A prior investigation (Brown, Note 1) indicates that this is not the case. Subjects freely retrieved either one or three members of a specific semantic memory category. The name retrieval latency for the subsequently presented picture was hampered by three retrievals from the same category, compared to one. However, when the immediately prior "free" retrievals were from an unrelated category, there was no difference between one and three retrievals. If effort was hampering later retrievals, the "three" condition should have been slower than the "one" condition with both same and different prior categories. Another refutation of the effort position comes from an examination of the change in retrieval latencies across the entire presentation sequence. If effort-induced slow-down was occurring, there should be a general increase in retrieval times across the entire list. This did not occur in the present study, or in Brown (1981, Exp. 5).

Aside from supporting the outcome found by Brown (1981) of generally increasing retrieval times across successive retrievals from the same semantic category, this investigation may help resolve the discrepancy between the decrease found by Loftus (1973; Loftus & Loftus, 1974) and the increase found by Brown (1981). With Loftus, the frequency of association level was generally higher than for Brown. In the first investigation (Loftus, 1973), she used the first and third members of the category. This was presumably true in the second investigation, also, although the frequency level was not explicitly stated (Loftus & Loftus, 1974). In Brown (1981), the frequency level was much lower, on the average. At least the first five (Exp. 1) or eight (Exp. 2, 3, and 4) members were cued for. Therefore, the average frequency level of the exemplars was considerably lower in Brown'study.

Reference Notes

1. Brown, A. S. Self-generated priming in semantic memory retrieval. Paper presented at the Psychonomic Society Convention, Philadelphia, Pa., November, 1981.

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Footnotes

[1] For all analyses, a .05 significance level was used.

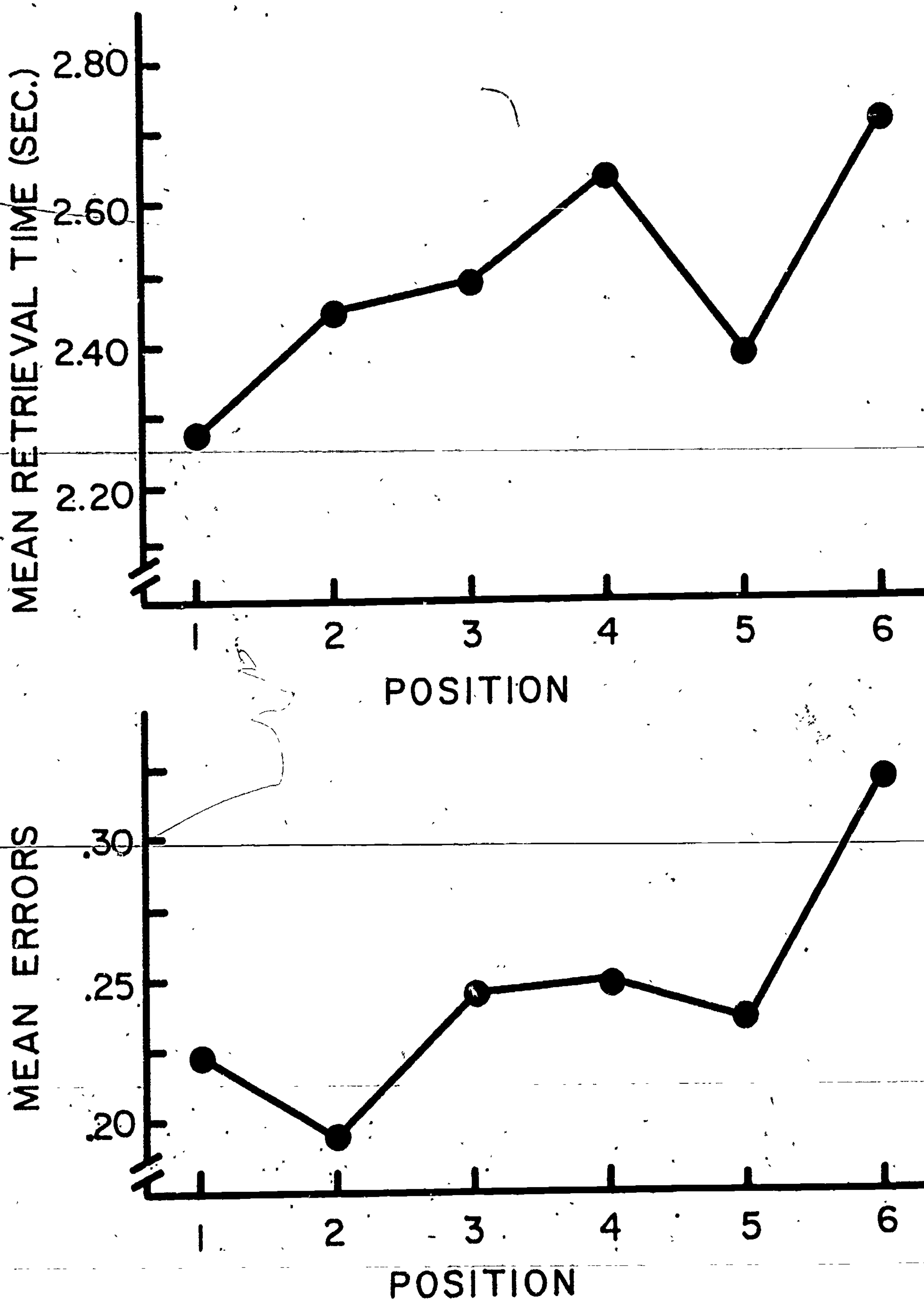
Requests for reprints should be sent to Alan S. Brown, Department of Psychology, Southern Methodist University, Dallas, Texas 75275.

Figure Captions

Figure 1. Retrieval latencies and errors across the six positions, combined over different frequency levels.

Figure 2. Retrieval latencies across the six positions separately for each frequency level.

Figure 3. Retrieval errors across the six positions separately for each frequency level.


MEAN RETRIEVAL TIME (SEC.)
2.80
2.60
2.40
2.20
1
2
3
4
5
6
POSITION
MEAN ERRORS
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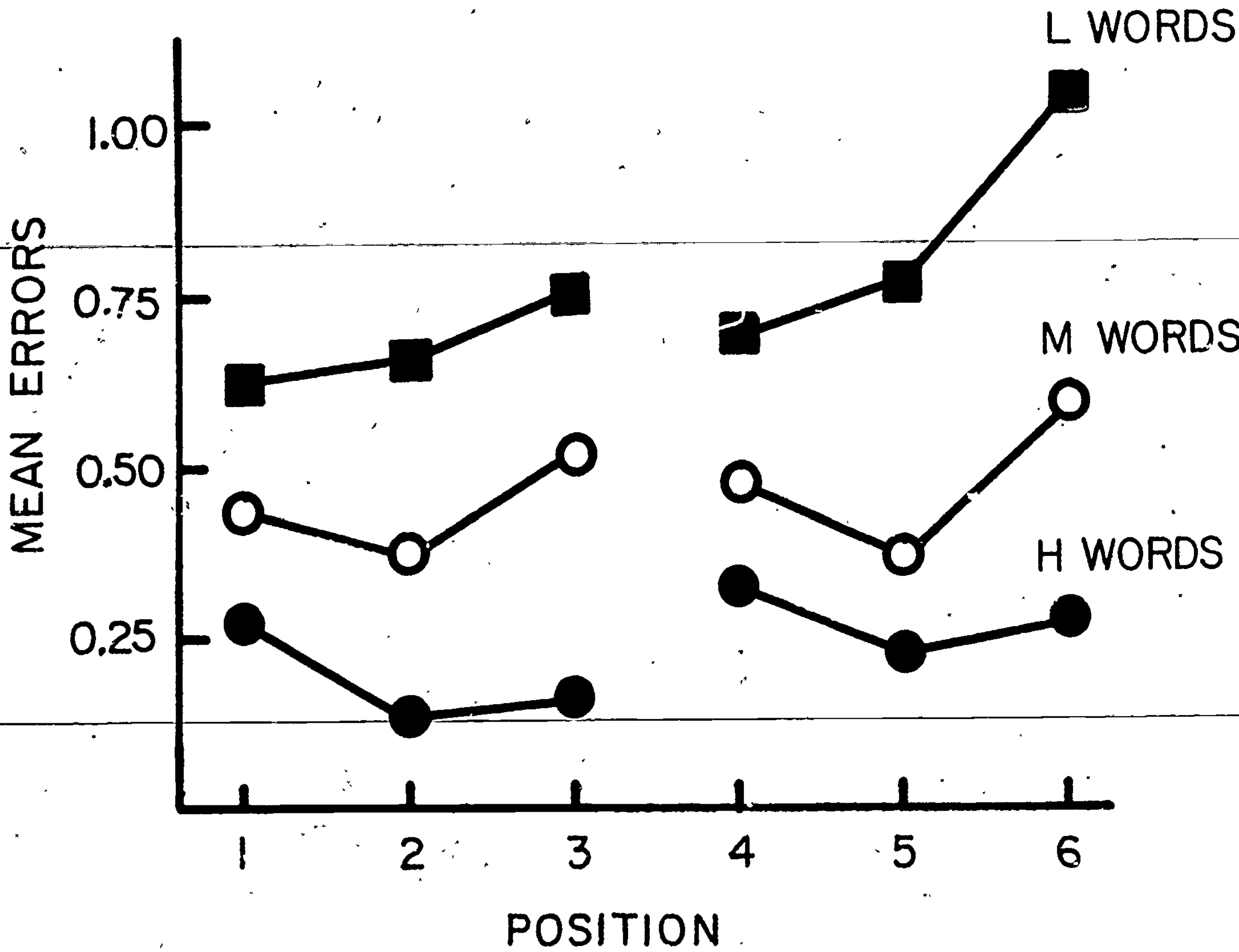
.25
.20
1
2
3
4
5
6
POSITION



L WORDS
M WORDS
H WORDS
MEAN ERRORS
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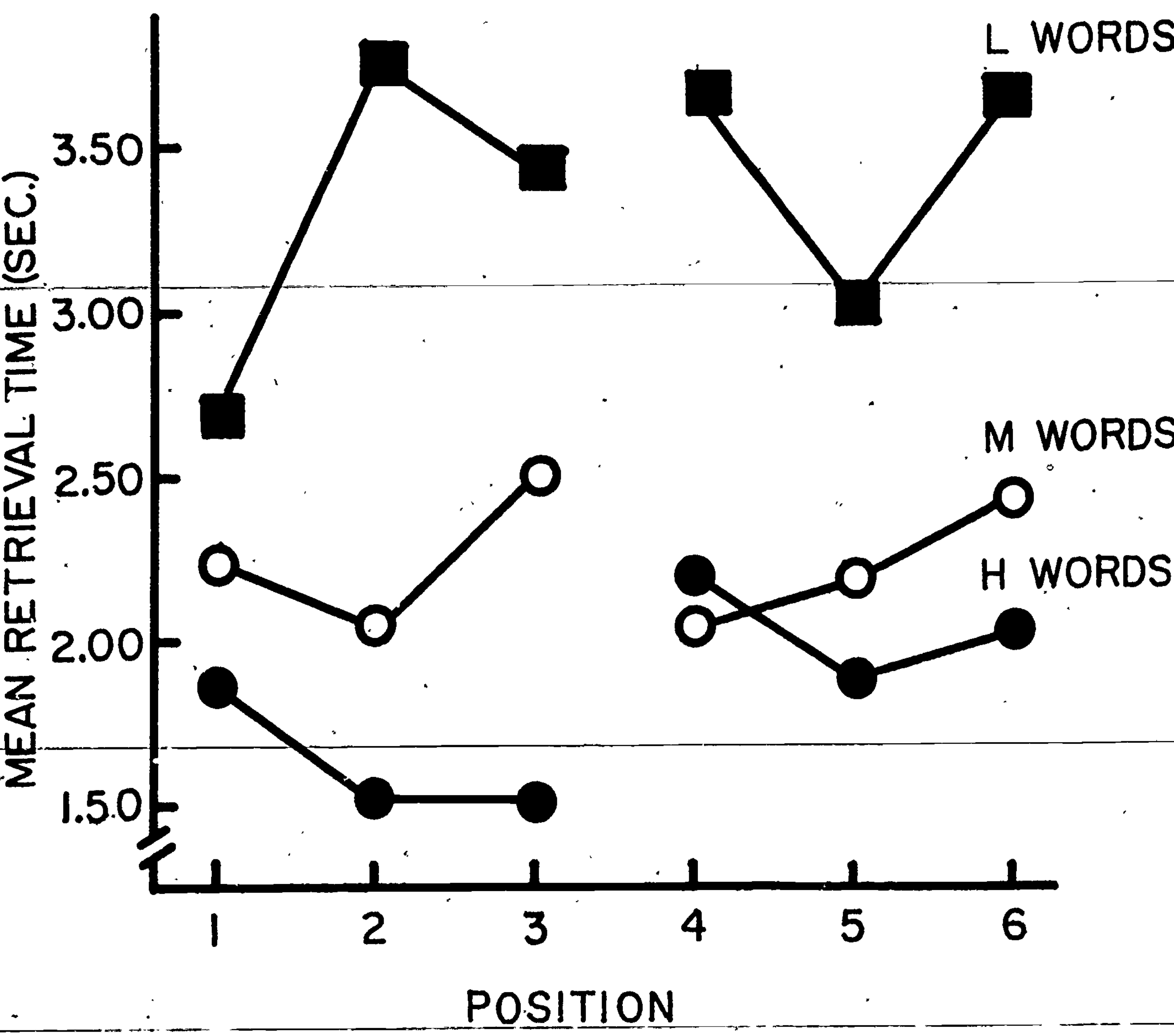
0.75
0.50
0.25
1
2
3
4
5
6
POSITION


L WORDS
M WORDS
H WORDS
MEAN RETRIEVAL TIME (SEC.)
3.50
3.00
2.50
2.00
1.50
1
2
3
4
5
6
POSITION