The isolation effect and mechanisms in short- and long-term memory

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The duration of tachistoscopic exposure (2.5, 10, and 20 sec) for 10-item lists was manipualted in an attempt to emphasize either short-term (STM) or long-term (LTM) memory. A Duration by Isolation interaction was hypothesized such that overall performance for isolated and unisolated lists would not differ in STM but that the overall performance for isolated lists would be superior to unisolated lists in LTM. The hypothesis was not supported. Performance for isolated lists was found to be superior for all three duration conditions. This result was explained in terms of an effective shortening of the encoded list caused by the presence of an isolated item.

When one inserts a distinctive item in the midst of similar items and presents the items to Ss to be learned, two very interesting observations of the resulting performance can be made. First, one can observe the performance on the isolated item and compare it with an item in a comparable position in an unisolated list. Second, the overall performance on the list with the isolated item can be compared with the performance on an unisolated list. The first observation has resulted in such consistency as to rank it one of the most robust effects in psychology, i.e., performance is better on the isolated item. The second observation has shown variability from experiment to experiment. The bulk of the research conducted by the first author (Cimbalo, 1969; Cimbalo, 1970) dealing with the isolation effect in STM and the data of other researchers in this area [see Wallace (1965) for an excellent review of the area] supports the hypothesis that there is no difference in overall performance between isolated and unisolated lists. This finding is consonant with the total-time hypothesis which is currently very prominent in the literature and has been used (Cimbalo, 1970) as support for an information-processing explanation of the isolation effect.

A much researched implication of an interference-theory explanation of the isolation effect is that overall performance for isolated lists should be better than for unisolated lists. A study by Smith & Stearns (1949) supports this implication but only in a very qualified way. They found that for the first list learned each day and then only on later trials was performance better for isolated lists.

The present study is an attempt to assess the isolation effect and total list performance in STM and LTM, i.e., for different acquisition times. Unlike the Smith and Stearns study, duration of presentation and not repeated presentations of a list was used to operationally define longer-term memory.

METHOD

Twenty-one females from an introductory psychology course who received credit toward their final course grade for their participation were used as Ss. A Scientific Prototype three-channel tachistoscope was used to present the material. The material consisted of 36-point futura-demi consonants and digits. Ten-item lists were placed on 5 x 7 in. index cards for presentation in the tachistoscope. In the unisolated condition, 10 randomly selected consonants were placed across the center of the card such that equal distances occurred between each item. In the isolated condition the above procedure was again employed except that a randomly selected digit from the set 2-9 was placed in the fifth position. Thirty-six lists were prepared in this manner, with one-half being of each type. The 36 lists were then randomized for presentation with the restriction that an equal number of isolated and unisolated lists occur in Lists 1-18 and 19-36. This restriction allows one to assess practice effects.

The S was given a verbal ready signal prior to the presentation of a list. An X then appeared in the center of the screen for 2 sec, then the list of items appeared followed by the word "respond," which also appeared visually. The lists were presented for 2.5-, 10-, or 20-sec durations. Ss were given 20 sec to record their responses in the order in which the items were shown.

RESULTS

Two major analyses were performed on the data. An overall performance analysis compared the various conditions, using the mean number of items correct/list as the dependent variable, and an item analysis used the mean number of isolated items correct/list and the comparable items in unisolated lists as the dependent measure.

Overall Performance Analysis

A 3 by 2 by 10 factorial design was used. Duration, isolation, and position were all within-S variables, with 3 (2.5, 10, and 20 sec), 2 (isolated and unisolated lists), and 10 (Serial Positions 1-10) levels, respectively.

All of the main effects and interactions were significant except the Duration by Isolation interaction, which was the major interest of this study. Overall performance for isolated and unisolated lists did not differ for the shorter- and longer-term memory stores, as defined in this studv.

As was expected, the main effects of duration ($F = 8.91$, $df = 2/40$, $p < .01$) and position ($F = 233.07$, $df = 9/180$, $p < .01$) were significant. The longer the duration of exposure, the better was performance. The serial-position effect can be seen in Fig. 1 to have a pronounced primacy effect and little, if any, recency effect.

The Duration by Position interaction with $F = 3.48$, $df = 18/360$, $p < .01$ indicated that performance was superior for the longer durations, but only for the last five positions. The Isolation by Position interaction with $F = 3.43$, $df = 9/180$, $p < .01$ is plotted in Fig. 1. This interaction shows that, in general, isolated lists show superior performance for the first seven serial positions, with especially good performance on the isolated and on the immediately adjacent items and essentially no performance differences for the last three positions. The significant isolation effect ($F = 6.12$, $df = 1/20$, $p < .05$) can best be understood in terms of the preceding interaction. Easily interpretable trends were not detected in the triple interaction ($F = 2.16$, $df = 18/360$, $p < .01$).

Comparisons of the first 18 and second 18 trials, i.e., Block 1 and Block 2, respectively, was performed in a separate analysis which showed that performance improves from Block 1 to Block 2 ($F = 8.85$, $df = 1/20$, $p < .01$). The Duration by Blocks interaction was also significant with $F = 16.01$, $df = 2/40$, $p < .01$, and it revealed that duration had

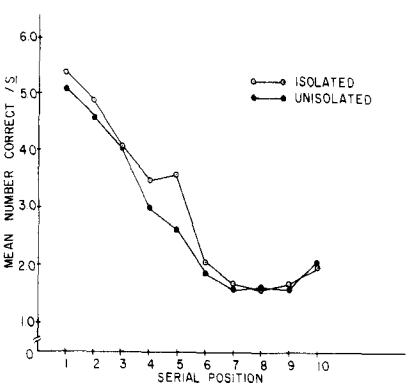

FIGURE 1 THE MEAN NUMBER OF CORRECT RESPONSES/S AS A FUNCTION OF SERIAL POSITION

an effect and was directly related to performance in Block 1 but had no effect in Block 2.

Item Analysis

The design was a completely within-S 3 by 2 by 2 factorial. Duration and isolation were the first two factors and the level descriptions were the same as in the preceding analysis. Blocks, the third factor, had two levels and involved a comparison of performance on Trials 1-18 with Trials 19-36.

The three main effects were significant and in the expected direction, and none of the interactions approached significance. Duration and performance were directly related, with $F = 4.90$, $df = 2/40$, $p < .05$. Isolated item performance was signficantly better than unisolated item performance, with $F = 17.97$, $df = 1/20$, $p < .01$. Blocks and performance were directly related, with $F = 4.47$, $df = 1/20$, $p < .05$.

DISCUSSION

In terms of the two observations mentioned in the introduction to the paper, i.e., overall performance and item performance for isolated and unisolated lists, the effects seem clear. Isolation was found to be a robust effect, and Ss performed better on isolated than on unisolated lists. Typically, however, it has been found that there were no differences in overall performance between isolated and unisolated lists (Cimbalo, 1969; Wallace, 1965).

A possible explanation for this difference might involve the fact that a simultaneous presentation of items was used in this study as opposed to the sequential presentation of items used in the earlier research. The simultaneous presentation might better enhance the effectiveness of the isolated item as an anchor point in rehearsal than the sequential presentation. The isolated item as an anchor point in rehearsal serves to shorten effectively the list that the S processes. Prior research (Cimbalo & Laughery, 1967) with this type of memory-span task indicated that Ss perform significantly better on shorter lists (seven consonants) than on longer lists (nine consonants). Therefore, according to this line of reasoning, better performance on the isolated lists resulted from an effective shortening of the list of items being processed. It is being argued that S is processing the first five items more effectively in the isolation condition than in the unisolated condition because, in effect, the unisolated list is longer. This type of explanation, i.e., in terms of the effectiveness of coding and/or retrieving the material does not conform to the total-time hypothesis, but then neither does the fact that Ss perform better on shorter lists than on longer lists where the time per item is the same. The isolated item may serve to optimize the number of items that the S can effectively process by regulating the channel processing capacity. Wickelgren (1964) reports what seems to be a related finding, i.e., Ss who rehearse in groups tend to perform better than Ss who do not group their items. Again, these findings are incompatible with a simple version of the total-time hypothesis.

Two theories that have been used to explain the isolation effect are an interference and an information-processing theory. The former maintains that isolation increases the differentiation of an item and reduces generalizability to the rest of the list. This reduction in generalizability leads to two predictions: (1) Overall performance should be superior on isolated lists, and (2) there should be a generalization gradient around the isolated item. Both of these predictions receive some support from this study (see Fig. 1 for the generalization gradient). Cimbalo (1970) offered an information-processing explanation for the isolation effect, which hypothesizes that more time is spent processing the isolated item. This theory very nicely predicts the absence of the superiority for overall performance on isolated lists in terms of a "rob Peter to pay Paul" explanation. The extra time spent on the isolated item leaves less time to process the other items in the list. However, if this explanation were coupled with the possibility that the isolated item serves to effectively shorten the length of the list then this theory would make predictions quite similar to an interference theory.

This study does not provide a clear choice between these alternative theories but it does provide a possible explanation regarding the disparate results obtained for overall list performance in isolation experiments. If the isolation and/or presentation conditions are such as to allow S to successfully bifurcate the list, overall list performance for isolated lists will be superior.

REFERENCES

CIMBALO, R. S. Effects of item isolation upon the processing of serially presented information. Unpublished doctoral dissertation, State University of New York at Buffalo, 1969.

CIMBALO, R. S. Short-term memory: The isolation effect with controlled output. Proceedings of the American Psychological Association, 1970, 81-82.

CIMBALO, R. S., & LAUGHERY, K. R. Short-term memory: Effects of auditory and visual similarity. Psychonomic Science, 1967, 8, 57-58.

SMITH, M. H., JR., & STEARNS, E. G. The influence of isolation on the learning of surrounding materials. American Journal of Psychology, 1949, 62, 369-381.

WALLACE, W. P. Review of the historical, empirical, and theoretical status of the von Restorff phenomenon. Psychological Bulletin, 1965, 63, 410-424.

WICKELGREN, W. A. Size of rehearsal group and short-term memory. Journal of Experimental Psychology, 1964, 68, 413-419.