Semantic as opposed to acoustic encoding in STM¹

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The Ss were given triads of consonants or words in the Peterson and Peterson situation. After PI had been built up for the CCCs the Experimental group was given a word trigram such as Pea, Kay, Bee and the Control group received the homophonic triad P, K, B. A significant improvement in performance was shown for the Experimental group and none for the Control. It is concluded that semantic factors override any acoustic factors which might operate in this type of STM situation.

A study by Wickens & Simpson (1968) casts doubt on the widely held view (Adams, 1967; Neiser, 1967) that acoustic factors are the major source of interference in STM. In the Wickens and Simpson experiment, which used the Peterson & Peterson (1959) design, Ss were presented with three spelled-out numbers, then engaged in color naming for 20 sec, and finally attempted recall of the numbers. The Experimental and Control groups were treated alike on the first three trials, and both groups showed a significant decline in correct responses across trials, indicating that PI was building up. It is a typical finding in the Peterson and Peterson method that performance declines from the first to the third or fourth trial on the same class of material, presumably as a consequence of proactive inhibition (Keppel & Underwood, 1962; Loess, 1967; Wickens, Born, & Allen, 1963). On Trial 4 the target item for the Control group was "eight, two, one" and for the Experimental group it was "ate, too, won." The performance of the Control group continued at a low level on this trial whereas the Experimental performed as well as it had on the first trial of the experiment, showing no evidence of PI. The difference between the two groups was significant at $p < .01$. A second experiment varied the order of the critical item and obtained similar results. Since the two target items were acoustically identical but the two groups performed differently as a function of the conceptual class from which the items were drawn it was concluded that acoustic interference is of little significance in this type of STM situation. The present study is a conceptual repetition of the Wickens and Simpson experiment, using consonants and their word homophones rather than numbers.

Subjects

The Ss were 36 students from Introductory Psychology classes at The Ohio State University. There were 18 Ss in each of the two groups and Ss were assigned to their groups in alternate order of appearance.

Procedure

The Peterson and Peterson procedure was employed with color naming to a 1 sec metronome beat as the non-rehearsal activity and a recall interval of 20 sec. The specific sequence of procedure for S was as follows: (1) an asterisk as a ready signal for 2 sec; (2) the target item, which S read aloud, for 2 sec; (3) four color matrices of nine colors each, appearing for 5 sec each (to make a 20 sec retention interval); (4) a question mark, signaling that it was time to recall, which remained for 8 sec. Thus there were 30 sec between target items. The material was presented by a Carousel projector controlled by a tape timer.

The target items contained three units, which were either words or consonants. Specifically they were on consecutive trials as follows: EAT, ASK, YET; CNQ; DARE, YARD, EASY; XPI; TZK; WIN, EAT, AGE; SHOW, DEAR, WILL; JXP; BTR; XJC. On the final critical trial the stimuli for Experimental and Control groups were JAY, ARE, SEA vs JRC; WHY, TEA, KAY vs YTK; and PEA, KAY, BEE vs PKB. One third of the Controls and one third of the Experimentals were run on each item. The S wrote his responses on a card on the critical trial, thus permitting E to be assured as to how it was encoded. All Ss encoded according to the slide. The purpose of the first items in the series was to accustom

Ss to shifting from one to another class of materials, and the purpose of the three consecutive CCCs was to build up PI for CCCs before the critical 11th trial. Both groups were treated alike on the first 10 items.

Results

The data were analyzed in terms of correct vs incorrect responses where correct meant giving all the items in the original order. On Trial 10, the trial preceding the critical items, both groups had identical scores of 8 out of 18 correct. On the critical trial the Control group Ss were correct in 7 of 18 instances (or 37%) and the Experimentals were correct in 14 of the 18 instances (or 78%). A $\chi^2 = 4.11$ was obtained for trial 11 and this is significant at $p < .025$ in a one tail test.

Discussion

Were acoustic factors important sources of interference, then the two groups should have behaved in the same fashion on the critical trial since the word and consonant triads were acoustically alike (with the possible exception of "why" as Y). The fact that the groups do differ in performance on Trial 11 indicates that the important variable is the conceptual class in which the material is encoded rather than its acoustic characteristic. In other words, if items are encoded into different conceptual categories, they do not interfere with each other, even though they may be phonetically identical. An interpretation of this is presented more fully in the Wickens and Simpson paper. In summary, the results of the present experiment are in accord with those of the Wickens and Simpson experiment in suggesting (with a different class of materials) that conceptual or semantic factors override any acoustic factors that may operate (assuming they are present at all) in this type of STM situation. Together the two experiments suggest that the heavy emphasis on acoustics in STM may result from the limited class of materials often used (CCCs) rather than arising from a basic characteristic of STM.

It is possible, however, that the technique used by Baddeley (1966), Conrad (1964), and Wickelgren (1965), all of which stress the importance of acoustic factors, are more subject to this influence than is the Peterson and Peterson technique. In the latter technique the usual time between interfering items is relatively long (30 sec) as compared with a few seconds in the method used by the former investigators.

REFERENCES

- ADAMS, J. A. *Human memory*. New York: McGraw-Hill, 1967.
- BADDELEY, A. D. Short-term memory for word sequences as a function of acoustic, semantic and formal similarity. *Quart. J. exp. Psychol.*, 1966, 18, 362-365.
- CONRAD, R. Acoustic confusions in immediate memory. *Brit. J. Psychol.*, 1964, 55, 75-83.
- KEPPEL, G., & UNDERWOOD, B. J. Proactive inhibition in short-term retention of single items. *J. verbal Learn. verbal Behav.*, 1962, 1, 153-161.
- LOESS, H. Short-term memory, word class and sequence of items. *J. exp. Psychol.*, 1967, 74, 556-561.
- NEISER, U. *Cognitive psychology*. New York: Appleton-Century-Crofts, 1967.
- PETERSON, L. R., & PETERSON, M. J. Short-term retention of individual verbal items. *J. exp. Psychol.*, 1959, 54, 157-173.
- WICKELGREN, W. A. Acoustic similarity and intrusion errors in short-term memory. *J. exp. Psychol.*, 1965, 70, 102-108.
- WICKENS, D. D., BORN, D. G., & ALLEN, C. K. Proactive inhibition and item similarity in short-term memory. *J. verbal Learn. verbal Behav.*, 1963, 2, 440-445.
- WICKENS, D. D., & SIMPSON, H. K. Semantic vs phonetic encoding in short-term memory. *Midwestern Psychological Association*, 1968.

NOTE

1. This research was supported in part by the NIH Training Grant MH 08526.