Acoustic similarity and RI in PAL

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With the A-B, C-D paradigm it is shown that for both STM and LTM first list retention is unaffected by the degree of acoustic similarity between the stimuli of the IL and OL lists when numbers are used as responses.

Dale & Baddeley (1968) and Bruce & Murdoch (1968) have both failed to find any substantial effects of acoustic similarity in PAL (paired-associate learning) when the responses are words and stimulus similarity is manipulated using the A-B, C-D paradigm. This is true of both LTM and STM, although some statistically significant though small effects have been found in STM when all stimuli in the list are similar to each other. The implication of these results is that acoustic coding is not employed in PAL. However, it is possible that this is only true of tasks in which words are used as responses. Since in PAL the essential link which must be established is between S and R items, it is highly likely that when both are words the S uses their semantic or associative properties. The hypothesis examined in the present set of experiments is that if numbers were substituted as Rs the dominance of semantic coding would disappear and effects of acoustic similarity would become demonstrable.

EXPERIMENT 1

Method

The stimuli were drawn from a pool consisting of four sets of 12 acoustically similar CVC words which also had a high degree of formal similarity viz DIP, PIN, DIN, PIT, BIT, etc. and DEN, PEN, SET, BET, etc. These were paired with two-digit numbers. Two counterbalanced tests, A and B, were constructed from this material such that Ss used in the six control lists of Test A were used in the six experimental lists of Test B and vice versa. The R paired with each particular S was kept constant in this design so that the difficulty of particular pairs would also be counterbalanced.

The digits were allocated so that apart from an isolated oversight, no first place nor any second place digit occurred twice within a list.

Each list contained four S-R pairs. In control lists all the stimuli had different vowels viz TEN, DOG, BIN, BAT, and were therefore acoustically dissimilar. Experimental lists were of two kinds. Three had four stimuli with the same vowel (E4) and three had two pairs with the same vowel (E2). With the first E2 list, the pairs were adjacent in the presentation order. With the second list, similar stimuli alternated. With the third list, one pair occupied Positions 1 and 4 while the other was adjacent in Positions 2 and 3.

The Ss were tested in groups. Presentation was visual, the material being hand-written with a marker pen on 5 in. x 21 in. cards which were held up by E. Exposure was for 4 sec per pair, with no interitem interval. Retention was tested immediately after the single presentation. The Ss responded by writing on specially prepared answer sheets. Four sec per response was allowed. The interlist interval was 10 sec. Twelve different test orders were selected. These were counterbalanced so that orders used for control lists in Test A were used with experimental lists in Test B.

Instructions in which the analogy with learning challenge and password pairs was stressed, were reinforced by a single practice list.

All Ss were young enlisted men. Two groups of 25 were employed, one with each test.

Results

Performance was generally poor. The overall mean percentage of correct responses was 30.92 for experimental lists and 29.67 for control lists. Twenty-seven of the 50 Ss scored more highly on experimental lists than on control lists, whereas 18 scored more on control lists. Performance on E4 lists was better than on E2 lists,

the mean percentages being 34.00 and 27.83, respectively. This difference which is contrary to expectation is not statistically significant.

Clearly these results are contrary to our hypothesis.

EXPERIMENT 2

In this experiment single letters were used as Ss and single digits as Rs. On experimental trials the Ss were drawn from the set B C D G P T V which are highly confusable, whereas control list Ss were drawn from the set D F H L N Q Y which confuse relatively rarely (Conrad, 1964). Procedural details were the same as for Experiment 1: Four pairs were presented on each trial at a 4 sec rate and retention was tested immediately, allowing 4 sec for each item. The intertrial interval was 10 sec. Presentation was visual and Rs were written.

Two independent groups were tested, A and B. Each learned a separate sample of six experimental and six control lists in an alternating order. For each group six different orders of test were selected and each was used with one experimental and one control list.

Forty-one young enlisted men served as Ss. Twenty-two, tested together, constituted Group A, and 19, also tested together, constituted Group B.

Results

The overall mean percentage of correct Rs was 48.4 for experimental lists and 52.24 for control lists. This small difference in the expected direction was not statistically significant ($t = 1.23$, 40 df).

Discussion

This experimental procedure remedies two defects in Experiment 1 by (a) employing stimulus material known to lead to substantial effects with other procedures (Conrad, 1964), and (b) producing a performance level at which effects are more likely to be revealed. Despite these methodological improvements significant effects are absent and we are therefore led to conclude that they are generally absent in STM versions of PAL.

EXPERIMENT 3

The group testing LTM procedure used in this experiment followed closely that used by Dale & Baddeley (1968). The four list design was taken from Baddeley & Dale (1966). Four groups were required, one learning A then B, one A then Y, one X then B, and finally one learning X then Y. In preparing the experimental material (cf. Table 1), care was taken to avoid any acoustic similarity between any pair of members of Lists A and Y and also of Lists X and B. Likewise the material was vetted to eliminate any inadvertent semantic or strong associative links between Ss both within and between lists. In selecting R items the aim was to maximize discriminability and equate difficulty. Therefore ascending and descending triples were avoided and as far as possible different digits were used in each place within each list. The pairs were presented visually at a rate of 4 sec per pair. The material was printed with 2.5 in. lower case rubber stamps on 5 in. x 21 in. cards which were held up so as to be clearly visible to the whole group of Ss. Presentation was followed after 10 sec by a test trial in which Ss alone were presented (for 4 sec each). Rs were

Table 1
Lists Used in the LTM Experiment

A	B	X	Y
Deed 162	Bead 142	Dine 935	Sign 183
Firm 978	Germ 261	Rate 726	Bait 319
Loom 394	Fume 354	Fond 674	Wand 473
Ball 748	Haul 418	Fret 582	Debt 514
Skim 658	Skin 524	Soil 429	Foil 691
Dare 539	Pair 634	Lout 397	Gout 758
Pane 481	Vain 782	Duck 285	Duck 837
Know 276	Crow 893	Drink 194	Brink 946

Table 2
Performance Levels in the Matched Groups

Group	N	OL*	IL*	Retest†
AB	11	73.86	69.32	39.33
XY	11	73.86	71.59	45.36
Mean		73.86	70.45	42.34
AY	11	73.86	69.32	48.10
XB	11	73.86	72.73	54.92
Mean		73.86	71.02	51.51

* Mean percentage correct

† Mean percentage retained

written in specially prepared booklets, one page being used for each trial. Eight trials of OL were followed by eight trials of IL. New response booklets were used for IL. For the retest of OL, Rs were written on the back of the last page of the IL booklet. This test was not expected by the Ss. The necessary additional instructions were given immediately after the last IL trial.

One hundred and sixteen young enlisted men from the source used previously and which was also used by Dale & Baddeley (1968) and Baddeley & Dale (1966) served as Ss. They were tested in groups. The size of group tested was not completely under the control of the E.

Results

Retention was computed by expressing each S's retest score as a percentage of his score on the final OL trial. (Two instances where retest scores exceeded OL scores were treated as perfect retention.) The overall means were 45.1 for the experimental groups (i.e., AB and XY, $N = 59$), and 46.6 for the control groups (AY and XB, $N = 57$). For subsequent analysis, Ss with three or fewer correct Rs on the last trial were ignored and matched groups were extracted from the remainder. (This procedure of matching on OL scores and also as far as possible on IL scores was used by Baddeley & Dale, 1966.) Mean performance figures for these groups ($N = 11$) are given in Table 2. Retention was poorer with similar IL, but analyses of variance computed both on the percentage retained and on an arc-sine transformation of these data showed that none of the differences approached statistical significance.

GENERAL DISCUSSION

These results clearly show that RI is unaffected by stimulus similarity along the acoustic dimension when numbers are used as Rs. Thus the contrast between the marked effect of acoustic similarity in serial learning and its weakness or absence in PAL is emphasized.

At least two possible explanations for this difference can be advanced. One is that despite the use of numbers as Rs the PAL task still involved the formation of meaningful or associative links between S and R terms. Numbers were intended to be Rs which were devoid of meaning and associations, but the possibility remains that they are not. This is reinforced by the observation that associative norms to numbers can be established (Battig & Spera, 1962). The alternative explanation is that the comparison with serial learning is false. Experiments which have revealed substantial effects of acoustic similarity (e.g., Conrad, 1964; Baddeley, 1966) have employed a single small vocabulary of items from which all the Ss were drawn so that the Ss were repeatedly required to learn similar lists. This is conducive to the build up of PI. It is possible that the strong effects reported are dependent upon these conditions and that if a different vocabulary were used on every trial, as has been the case in these PAL experiments, acoustic similarity would be less disruptive.

REFERENCES

- BADDELEY, A. D. Short-term memory for word sequences as a function of acoustic semantic and formal similarity. *Quarterly Journal of Experimental Psychology*, 1966, 18, 362-365.
- BADDELEY, A. D., & DALE, H. C. A. The effect of semantic similarity on retroactive interference in long- and short-term memory. *Journal of Verbal Learning & Verbal Behavior*, 1966, 5, 417-420.
- BATTIG, W. F., & SPERA, A. J. Rated association values of numbers from 0-100. *Journal of Verbal Learning & Verbal Behavior*, 1962, 1, 200-202.
- BRUCE, D., & MURDOCH, B. B. (Jun.) Acoustic similarity effects in short- and long-term memory. *Journal of Verbal Learning & Verbal Behavior*, in press.
- CONRAD, R. Acoustic confusion and immediate memory. *British Journal of Psychology*, 1964, 55, 75-84.
- DALE, H. C. A., & BADDELEY, A. D. Acoustic similarity and interference in long- and short-term memory. (In preparation, copies available on request.)

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