

Reported mediators and individual differences in mental imagery

JOHN T. E. RICHARDSON

Brunel University, Uxbridge, Middlesex UB8 3PH, England

This study concerns the use of postlearning questionnaires to discover the strategies employed by subjects in memory tasks. Experiment 1 showed that the proportion of items for which subjects reported the use of imaginal mediators was an excellent predictor of their overall performance. Experiment 2 showed that this was true for concrete material, but not for abstract material. It is suggested that mediator reports provide an effective way of investigating individual differences in the use of mental imagery.

There is now substantial evidence that mental imagery is an important factor in many psychological tasks (Paivio, 1971). This research has used three different approaches for studying imaginal processes: the use of instructions to subjects to use mental imagery in these tasks, the comparison of stimulus material in terms of its imageability or concreteness, and the study of differences among subjects in their use of mental imagery (Paivio, 1972). While the first two methods have shown substantial and reliable effects upon performance, especially in the case of memory tasks, the study of individual differences has failed to produce consistent effects attributable to mental imagery (Bower, 1972; Paivio, 1971; Richardson, 1976). A few psychological experiments have used postlearning questionnaires, in which the subjects were asked to describe the sort of strategies or mediators that they had used to remember different stimulus items (Paivio, 1971, pp. 355-359). These reports were analyzed in terms of the different sorts of item used and in terms of the subjects' performance. However, they have only been used to test hypotheses concerning the memorability of different stimulus items, and not as measures of the mnemonic strategies employed by different subjects. I report two experiments that suggest that the use of reported mediators is an effective way of investigating individual differences in the use of mental imagery.

Research using postlearning questionnaires has found that the number of subjects who report the use of mental imagery for a given item correlates strongly with the memorability of that item; on the other hand, the number of subjects who report the use of verbal mediators does not predict performance; finally, items for which subjects report imaginal mediators are recalled better than items for which subjects report verbal mediators (Paivio, Smythe, & Yuille, 1968; Paivio, Yuille, & Smythe, 1966). These results seem to have the obvious corollaries that the number of imaginal mediators reported by a given subject in a memory task should predict his performance, that the number

of verbal mediators reported by a given subject should not have predictive value, and that subjects who tend to report imaginal mediators should produce better performance than subjects who tend to report verbal mediators. Accordingly, the following experiment was carried out to relate mediator reports to performance in paired associate learning.

EXPERIMENT 1

Method

The materials were 100 English nouns of frequency AA or A in the count of Thorndike and Lorge (1944). These were randomly assigned to 50 pairs, of which the first and last 5 were regarded as filler items to remove the primacy and recency effects in recall. The subjects received standard paired associate learning instructions, and the material was read out at a rate of 10 sec/pair. Immediately afterward, they received a prepared sheet containing the 40 critical stimulus terms in a random order and were asked to provide the response term in each case. They were allowed 5 min for written recall and then received a postlearning questionnaire. This contained the 40 critical paired associates, and the subjects were asked to indicate for each the type of mediator they had employed ("imagery," "verbal," "repetition," "other," or "none"). The instructions followed those of previous studies (Paivio, Smythe, & Yuille, 1968) and included examples of the different types of strategy. The subjects were 26 students at Brunel University who were taking an introductory course in laboratory methods, and who were tested as a group.

Results

The use of imaginal mediators, verbal mediators, and rote repetition was reported for 65%, 11%, and 13% of the pairs, respectively, and the mean correct recall was 48.5%. Stepwise multiple regression was employed to study the predictive capacity of four indexes of mediator use: the proportion of imaginal mediators reported by each subject, I ; the proportion of verbal mediators reported by each subject, V ; the difference between these two indexes, $I - V$; and the relative proportion of imaginal as opposed to verbal mediators, $I/(I + V)$. The simple correlation coefficient between each of these variables and the proportion of

items correctly recalled was +.80, -.32, +.71, and +.44, respectively. The first of these was highly significant [$F(1,24) = 42.00, p < .001$], but the three remaining indexes did not predict recall when the effect of I was statistically controlled ($|r| < .30, p > .10$ in each case). Thus the proportion of imaginal mediators appears to be the effective index of performance.

To establish the generality of this result across both experimental subjects and stimulus pairs, an analysis of variance was carried out that considered both as random factors (cf. Clark, 1973; Richardson, 1975). The subjects were classified as high or low imagers, depending upon whether the proportion of imaginal mediators fell above or below the overall median. The two groups reported using imaginal mediators for 87% and 43% of the pairs, and their mean correct recall was 68.9% and 28.1%, respectively. The analysis of variance showed that the high imagers were significantly better than the low imagers in recall performance [quasi $F(1,30) = 21.25, p < .001$].

Discussion

This experiment has shown that the proportion of imaginal mediators a subject reports is an excellent predictor of his memory performance. On the other hand, the proportion of verbal mediators he reports does not have predictive value. Measures of the relative use of imaginal as opposed to verbal mediators are also correlated with performance, but the absolute number of imaginal mediators seems to be most important as an index of recall.

Previous research has shown that the use of imaginal mediators is greater with concrete imageable material, whereas the use of verbal mediators does not vary with the concreteness of the material (Paivio et al., 1968). Moreover, imaginal mediators produce better performance than verbal mediators when the material is concrete, but not when it is abstract (Paivio et al., 1966). This suggests that the proportion of imaginal mediators a subject reports will have predictive value for the recall of concrete pairs, but not for the recall of abstract pairs. This prediction was tested in a second experiment.

EXPERIMENT 2

Method

The materials were 40 English nouns of frequency AA or A (Thorndike & Lorge, 1944) with imagery and concreteness ratings of more than 6.3 in the norms of Paivio et al. (1968), and 40 English nouns of frequency AA or A with imagery and concreteness ratings of less than 5.5. Each set of nouns was randomly assigned to 20 pairs, and the two sets were randomly ordered in a single list of 40 pairs. Ten similar pairs were added as primacy and recency fillers, making a total list of 50 paired associates. The procedure was identical to that of Experiment 1, except that the material was presented visually, typed on blank index cards, and the subjects were tested in pairs. The subjects were 20 students at Brunel University, who were taking

introductory courses in psychology, and who were paid for their participation.

Results

In the case of the concrete material, the use of imaginal mediators, verbal mediators, and rote repetition was reported for 62%, 19%, and 10% of the pairs, respectively, and the mean correct recall was 54.5%. The simple correlation coefficient between each of the four indexes described in Experiment 1 and the proportion of items correctly recalled was as follows: I, +.69; V, -.39; I - V, +.59; and I/(I + V), +.56. The first of these was highly significant [$F(1,18) = 16.31, p < .001$], but the three remaining indexes did not predict recall when the effect of I was statistically controlled ($|r| < .45, p > .05$ in each case). Thus the proportion of imaginal mediators appears to be the effective index of performance on concrete pairs.

In the case of the abstract material, the use of imaginal mediators, verbal mediators, and rote repetition was reported for 26%, 37%, and 21% of the pairs, respectively, and the mean correct recall was 34.0%. The simple correlation coefficient between each of the four indexes described in Experiment 1 and the proportion of items correctly recalled was as follows: I, +.35; V, +.01; I - V, +.19; and I/(I + V), +.16. None of these approached statistical significance [$F(1,18) < 2.50, p > .10$ in each case]. Thus the use of imaginal and verbal mediators does not appear to predict the recall of abstract pairs.

To establish the generality of these results, separate analyses of variance were carried out upon the data from the concrete and abstract material that considered both subjects and stimulus pairs as random factors. The subjects were classified in each case as high or low imagers, depending upon whether the proportion of imaginal mediators fell above or below the corresponding overall median. This classification produced a significant effect in the case of the concrete pairs [$F(1,18) = 9.24, p < .01$], but not in the case of the abstract pairs ($F < 1$). Finally, it was noted that the proportion of imaginal mediators employed with the concrete pairs was significantly correlated with the proportion of abstract pairs correctly recalled [$r = +.62, F(1,18) = 11.44, p < .005$], but that the proportion of imaginal mediators employed with the abstract pairs was not correlated with the proportion of concrete pairs correctly recalled [$r = +.39, F(1,18) = 3.22, p > .05$].

GENERAL DISCUSSION

Experiment 2 has shown that the proportion of imaginal mediators that a subject reports is highly correlated with his ability to recall concrete material, but not with his ability to recall abstract material. This confirms the suggestion of previous research that the usefulness of mental imagery as a mnemonic strategy

is related to the concreteness of the material to be remembered (e.g., Paivio & Foth, 1970; Paivio et al., 1966). On the other hand, the proportion of verbal mediators that a subject reports does not predict his performance on either concrete or abstract material.

Both of the experiments reported in this paper have shown substantial and significant relationships between mediator reports and performance in paired associate learning. However, the results must be interpreted with care, since the data are entirely correlational, and the causal sequence remains uncertain (cf. Paivio, 1971, p. 359). For example, it is possible to characterize the results of Experiment 1 by saying that good memorizers tend to report mental imagery. The results of Experiment 2 create some difficulty for this suggestion, since the subjects who produced good performance on the abstract pairs did not tend to report mental imagery. In this case, a more convoluted suggestion may be made: "The instructions for the questionnaire may have suggested to the subjects that they must have used some type of associative aid, and the image-arousing value of the items appearing on the questionnaire may then have influenced their choice of the imagery category just as it influenced their learning" (Paivio, 1971, p. 359). However, as Paivio himself pointed out, on this view it is difficult to see why verbal mediators fail to show strong relations to item attributes and to learning when subjects have as much opportunity to report such mediators as they do mental imagery.

While the performance on the abstract material did not show any relationship with the mediators reported for that material, it was significantly associated with proportion of imaginal mediators reported for the concrete material. This curious finding obviously stands in need of experimental replication. One interpretation might be that the best subjects are those who change their mnemonic strategies in a manner appropriate to the concreteness of the material to be remembered. While mental imagery appears to be appropriate for learning concrete material, it is not clear what alternative strategy might be employed for learning abstract material, since the use of verbal mediators shows no relationship with performance.

This investigation has demonstrated a reliable correlation between the proportion of imaginal mediators that a subject reports in a paired associate learning task and his recall performance. This relationship was affected in the anticipated manner by variation in the concreteness of the stimulus material. Bearing in mind the correlational nature of the experimental designs, the results suggest that future research into individual differences in the use of mental imagery will benefit from the study of reported mediators.

REFERENCES

- BOWER, G. H. Mental imagery and associative learning. In L. W. Gregg (Ed.), *Cognition in learning and memory*. New York: Wiley, 1972.
- CLARK, H. H. The language-as-fixed-effect fallacy: A critique of language statistics in psychological research. *Journal of Verbal Learning and Verbal Behavior*, 1973, 12, 335-359.
- PAIVIO, A. *Imagery and verbal processes*. New York: Holt, Rinehart, & Winston, 1971.
- PAIVIO, A. A theoretical analysis of the role of imagery in learning and memory. In P. W. Sheehan (Ed.), *The function and nature of imagery*. New York: Academic Press, 1972.
- PAIVIO, A., & FOTH, D. Imaginal and verbal mediators and noun concreteness in paired-associate learning: The elusive interaction. *Journal of Verbal Learning and Verbal Behavior*, 1970, 9, 384-390.
- PAIVIO, A., SMYTHE, P. C., & YUILLE, J. C. Imagery versus meaningfulness of nouns in paired-associate learning. *Canadian Journal of Psychology*, 1968, 22, 427-441.
- PAIVIO, A., YUILLE, J. C., & MADIGAN, S. A. Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology Monograph*, 1968, 76(1, Part 2).
- PAIVIO, A., YUILLE, J. C., & SMYTHE, P. C. Stimulus and response abstractness, imagery, and meaningfulness, and reported mediators in paired-associate learning. *Canadian Journal of Psychology*, 1966, 20, 362-377.
- RICHARDSON, J. T. E. Statistical analysis of experiments investigating stimulus attributes. *British Journal of Mathematical and Statistical Psychology*, 1975, 28, 235-236.
- RICHARDSON, J. T. E. Procedures for investigating imagery and the distinction between primary and secondary memory. *British Journal of Psychology*, 1976, 67, 487-500.
- THORNDIKE, E. L., & LORGE, I. *The teacher's word book of 30,000 words*. New York: Teachers College, 1944.

(Received for publication January 23, 1978;
revision accepted April 21, 1978.)