

Subjects' reports in mental comparisons

JOHN T. E. RICHARDSON

Brunel University, Uxbridge, Middlesex UB8 3PH, England

Introspective reports showed that mental imagery is used in making mental comparisons among concrete objects in terms of both physical properties and abstract properties, but not in making mental comparisons among abstract items in terms of abstract properties, nor among individual words in terms of nonsemantic properties. This confirms previous research implicating mental imagery in symbolic comparison tasks.

Several recent experiments have investigated the processes involved when pairs of objects presented in a symbolic form (for example, as their names or as pictures) are compared along some dimension. These experiments have consistently demonstrated a number of basic findings. First, the time taken to make such mental comparisons varies inversely with the magnitude of the difference between the two objects along the relevant dimension. This symbolic distance effect has been obtained when concrete objects are compared in terms of physical properties such as size, shape, or color (Moyer, 1973; Paivio, 1975, 1978a, Note 1), when concrete objects are compared in terms of abstract properties such as ferocity, intelligence, military power, monetary value, or pleasantness (Banks & Flora, 1977; Kerst & Howard, 1977; Paivio, 1978c), when abstract concepts are compared in terms of abstract properties such as the evaluative dimension of the semantic differential (Friedman, 1978), and even when words are compared in terms of nonsemantic properties such as frequency and pronounceability (Paivio, 1978b). Second, mental comparisons are faster under pictorial presentation than under verbal presentation when concrete objects are compared along physical dimensions (Paivio, 1975, 1978a) or along abstract dimensions (Banks & Flora, 1977; Paivio, 1978c), but not when they are compared in terms of the frequency or pronounceability of their names (Paivio, 1975, 1978b). Third, subjects of high spatial ability carry out mental comparisons faster than those of low spatial ability when comparing concrete objects along physical dimensions (Paivio, 1978a, Note 1) or along abstract dimensions (Paivio, 1978c), but not when comparing their names along nonsemantic dimensions (Paivio, 1978c, Note 1).

These results are taken to imply that mental comparisons among concrete objects along semantic dimensions are made on the basis of imaginal representations (Paivio, 1975, 1978c), although there are some difficulties with this view (Banks, 1977). That the relevant effects occur also with abstract properties is ascribed

to the fact that these are attributes of things rather than words, and so it is equally necessary to construct mental images of those things in order to compare them with respect to those properties (Paivio, 1978b, 1978c). One category of evidence that has been relatively neglected is that of introspective reports. Paivio's (1975) initial experiments employed formal questionnaires that "indicated an overwhelming reliance on visual imagery," but he regarded this as only "supplementary evidence that such a process is functionally activated." The present investigation used such questionnaires in order to elicit introspective data on the strategies and processes employed in mental comparisons of concrete and abstract items along physical, abstract, and nonsemantic dimensions.

METHOD

Subjects

Thirty-four students taking introductory courses in psychology at Brunel University volunteered to participate in this experiment.

Materials

In the first part of this study, the material consisted of 10 pairs of named animals taken from Paivio (1975). In the second part, the stimuli were five pairs of concrete nouns (with imagery and concreteness ratings greater than 6.3 in the norms of Paivio, Yuille, & Madigan, 1968) and five pairs of abstract nouns (with imagery and concreteness ratings less than 5.6); all 20 words were rated AA or A in frequency according to Thorndike and Lorge (1944). Both sets of stimuli were presented in a constant randomized order.

Procedure

Each subject was given a booklet containing the instructions, the items to be compared, and a questionnaire. The first 24 subjects compared the 10 pairs of named animals; 4 subjects used each of the following dimensions: physical size, physical angularity, ferocity, intelligence, pronounceability, and frequency. The remaining subjects compared the 10 pairs of concrete and abstract concepts; five subjects used the evaluative dimension of the semantic differential (Osgood, Suci, & Tannenbaum, 1958), and five used the potency dimension. Each subject indicated which item in each pair was bigger, more angular, more ferocious, and so on, by circling one of two symbols, and then completed a questionnaire in which he indicated whether he had compared the members of each pair by making up a mental image, by thinking about them "in a more abstract, verbal way," by repeating the words over to himself, or in some other way.

Requests for reprints should be sent to John T. E. Richardson, Department of Psychology, Brunel University, Uxbridge, Middlesex UB8 3PH, England.

RESULTS

In comparing the 10 pairs of named animals, the overall reported use of the four different strategies was: mental imagery, 55%; verbal coding, 22%; repetition, 13%; and other, 11%. The reported use of mental imagery for the three types of dimension was: physical, 73%; abstract, 79%; and nonsemantic, 13%. An analysis of variance was carried out upon whether each subject had reported the use of mental imagery for each pair, in which the random factor of subjects was nested under the random factor of dimensions, in which the latter factor was nested under the fixed factor of conditions (types of dimension), in which the variation due to the three conditions was partitioned into the contrast between the physical and abstract dimensions and the contrast between these dimensions and the nonsemantic dimension, and in which there were repeated measures on the random factor of stimulus pairs. This confirmed that the use of mental imagery was not significantly different between the physical and semantic dimensions ($F < 1$), but that it was significantly different between these dimensions and the nonsemantic dimension [$F(1,18) = 21.3, p < .001$].

In comparing the 10 pairs of concrete and abstract nouns, the reported use of mental imagery for the concrete pairs was 92% on the evaluative dimension and 44% on the potency dimension. The values for the abstract pairs were 12% and 36%, respectively. An analysis of variance was again carried out upon whether each subject had reported the use of mental imagery for each pair, in which the random factor of subjects was nested under the random factor of dimensions, in which there were repeated measures on the random factor of stimulus pairs, and in which the latter factor was nested under the fixed factor of concreteness. The main effect of concreteness was not statistically significant [$F(1,1) = 1.42, p > .25$], since it was qualified by a significant interaction with the effect of dimensions [$F(1,8) = 19.64, p < .01$]. A posteriori tests showed that the effect of concreteness was significant for the evaluative dimension [quasi $F(1,22) = 23.9, p < .001$], but not for the potency dimension ($F < 1$).

DISCUSSION

The three sorts of experimental evidence described in the introduction to this paper have distinct implications for an understanding of the processing underlying mental comparison. The symbolic distance effect implies that the relevant information is represented in a continuous, analog form. The effect of presentation modality implies that this representation is more readily evoked by pictures of objects than by the names of objects. The effect of individual differences implies that this representation is also employed in spatial thinking. As Paivio (1978c, p. 207) remarked, "The combined influence of symbolic distance, picture superiority, and imagery ability in the present tasks strongly suggest that the comparison is based on information that is analog and continuous, as well as specifically nonverbal and imagistic in nature."

These suggestions were clearly confirmed by the results of the present study. Mental imagery was frequently reported as the representation employed to carry out symbolic comparisons. The use of mental imagery was influenced by the concreteness of the stimulus material, at least with the evaluative dimension, as one would expect. However, it was not influenced by the nature of the dimension along which the items were compared, provided that this was a semantic property of those items. This is in accord with the suggestion of Paivio (1978b, 1978c) that even comparisons along abstract dimensions are made on the basis of mental images of the named objects. On the other hand, also as one would expect, mental imagery did not contribute to the comparison of pairs of words along nonsemantic dimensions. The dimension of potency produced somewhat discrepant results, in that the moderate overall use of mental imagery was not qualified by the concreteness of the items being compared. This clearly needs to be followed up in future research. Nevertheless, the present investigation has otherwise provided excellent confirmation in the form of introspective reports of an account of mental comparisons based upon the use of mental imagery.

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