Time to understand pictures and words

WHEN an object such as a chair is presented visually, or is represented by a line drawing, a spoken word, or a written word, the initial stages in the process leading to understanding are clearly different in each case. There is disagreement, however, about whether those early stages lead to a common abstract representation in memory, the idea of a chair¹⁻⁴, or to two separate representations, one verbal (common to spoken and written words), and the other image-like'. The first view claims that words and images are associated with ideas, but the underlying representation of an idea is abstract. According to the second view, the verbal representation alone is directly associated with abstract information about an object (for example, its superordinate category: furniture). Concrete perceptual information (for example, characteristic shape, colour or size) is associated with the imaginal representation. Translation from one representation to the other takes time, on the second view, which accounts for the observation that naming a line drawing takes longer than naming (reading aloud) a written word^{6,7}. Here we confirm that naming a drawing of an object takes much longer than reading its name, but we show that deciding whether the object is in a given category such as 'furniture' takes slightly less time for a drawing than for a word, a result that seems to be inconsistent with the second view.

In each of three conditions with different adult subjects, 96 line drawings of objects or their names written in lower case Letraset (Berling 14 point) were presented one at a time in a tachistoscope, preceded and followed by a mask of haphazard lines and pieces of letters. Each subject saw half the 96 items as words and half as drawings, in alternating blocks of 16 items. Each item was presented as a drawing to half the subjects and as a word to the other half. The subject had never seen the drawing before it was presented. The experimenter said ready or (in the third condition) named a category before each presentation, and after an 800-ms interval the item appeared. A voice key was used to measure response time from the onset of the item.

To discover whether the drawings and words were equally discriminable as visual patterns, in the first condition 16 subjects were shown the items for brief durations, 40, 50, 60, or 70 ms. The durations were presented in a random order, permuted across subjects so that each item was shown equally often at each duration. Subjects named or read the items. The estimated exposure duration required to report 50% of the items correctly was 44 ms for the drawings and 46 ms for the words.

In the remaining two conditions items were presented for 250 ms, at a level well above threshold. Subjects in the second condition (n=8) named the object or the word aloud, as rapidly as possible. In the third condition (n=16)the experimenter named a category before the item appeared. The subject said yes if the item was a member of the category, as it was on half the trials, and said no otherwise. Altogether there were 18 categories containing two to nine items: for example, food (carrot, pie . . .), clothing (hat, coat . . .), tools (pliers, hammer . . .).

The results of the second and third conditions are shown in Fig. 1. As in earlier reports^{6.7} drawings took longer to name than words; the mean difference was 260 ms (standard error of the mean difference, 91 ms). The difference was in the same direction for all eight subjects (P<0.01, sign test), and for 93 of the 96 items (P<0.001). In the third condition drawings were categorised faster than words: a difference of 51 ms overall (standard error of the mean



Fig. 1 Mean response time in condition 2 (naming) and condition 3 (matching the item to a spoken category). The white bars are responses to drawings; the black bars, to words. Each bar is based on at least 350 responses; errors and responses that took longer than 2 s (together, less than 5", of the trials) were omitted.

difference, 42 ms). The difference was 57 ms for yes responses and 44 ms for no responses. Fourteen out of 16 subjects were faster with drawings than words (P < 0.01, sign test). Of the 96 items, 68 were matched faster as drawings (P < 0.001).

Recall that the second view of memory asserts that an object has two representations, and that an object's category (a verbal abstraction) is associated with its name and only indirectly with its appearance. If, as that view claims, a drawing must be named implicitly before its category is determined, then in the present experiment one would expect drawings to be categorised more slowly than words^{8,9}, just as they were named 260 ms more slowly. But drawings were not slower than words: they were 50 ms faster. Furthermore, a drawing was categorised much more quickly than it was named, which also makes it unlikely that naming preceded categorising. That finding is, however, not by itself conclusive, since a yes-no matching response may be simpler and so faster than overt naming.

Before one concludes that the second view is untenable, the following four objections must be considered.

(1) Drawings in a given category might have shared certain visual features, so a drawing may have been categorised rapidly on the basis of those features before the subject knew exactly what it was⁸. That is unlikely because the items were chosen to look as diverse as possible, and because at near-threshold durations (first condition) subjects rarely reported a drawing's category but not its name.

(2) Some words (for example, bear, tie, train) were ambiguous, and the first meaning assigned by the subject may not have matched the specified category. An analysis of just the unambiguous items, however, reduced but did not eliminate the advantage of drawings.

(3) Concrete words must be imaged to be categorised the converse of the naming hypothesis. That seems unlikely, since imaging a word is reported to require at least 0.5 s (ref. 5).

(4) The category of an item is independently associated to both its name and its appearance. Although our results

do not contradict that unparsimonious hypothesis, it would be surprising if a verbal category were more strongly associated with a drawing than a name.

The first view claims that written words and drawings (and presumably also spoken words and objects experienced directly) lead to a common representation in memory, neither word-like nor image-like, and it is that representation which is connected with knowledge of an item's category. In our study, that representation was reached more rapidly from drawings than from words. On this view, naming a drawing is slow because it requires an extra step from the abstract concept to its associated name, whereas naming a word only requires that the word pattern itself be identified1" and then it may be articulated even before the concept is evoked.

In sum, our results are consistent with the view that knowledge of the category of an object is associated with an abstract idea of the object rather than directly with its name or appearance. Since the name and appearance of an object are also represented in memory, a further question is whether other knowledge one has about an object (such as its typical size or value) is linked to the abstract

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concept or is directly associated with the name or image. The answer may help to resolve an old question: what are the functions of images and words in thought?

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