

# Understanding Pictures and Words: Comment on Potter, Kroll, Yachzel, Carpenter, and Sherman (1986)

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Although pictures are named more slowly than words, some meaning judgments can be made as quickly for both classes of stimuli. This finding has been taken as evidence that a common, conceptual system underlies the meaning of pictures and words. The results are also consistent, however, with a dual coding theory of meaning that postulates only modality-specific imaginal and verbal representations for pictures and words, respectively. The equal accessibility of words and pictures to some aspects of meaning is explained by diverse connections among the representations or by modality-specific components of meaning rather than by conceptual representations, which are actually unnecessary to explain the phenomena.

Potter, Kroll, Yachzel, Carpenter, and Sherman (1986) found that words and pictures permitted equally fast interpretation of sentences, even though words were named more quickly than pictures. They concluded that meaning was located in a nonlinguistic conceptual system, but at least one other theory can also explain their findings.

## Observations

Potter et al. based their conclusion on measures of the speed with which pictures and words can be understood on meaning tasks relative to the speed with which they can be named. Selected results from their pretest study and their Experiments 3 and 4 illustrate the relevant phenomena. Voice-key naming latencies were obtained for words and pictures that were presented alone (pretest) or as the last items in serially presented sentences (Experiment 4). The meaning measures were based on keypress reaction times for *yes-no* judgments about (a) whether words or pictures matched preceding category names (pretest) or (b) sentence plausibility (Experiment 3). The plausibility of each sentence was determined by the last item, which was presented as either a word or picture.

Table 1 summarizes selected results from Tables 1 and 3 in Potter et al. (1986). Pictures were approximately 200 ms slower than words on the naming tasks but showed little or no disadvantage on the meaning tasks. The effects are robust and reliable. The absence of a modality effect on plausibility judgments was replicated in several studies by Potter et al., and earlier research had demonstrated the naming versus categorization effect for individual pictures and words. Other research has shown that pictures are identified as rapidly as words, so that

the locus of the interaction appears to be subsequent to a perceptual identification stage and presumably involves the mechanisms by which names and meanings are retrieved for pictures and words.

## Lexical and Conceptual Theories

The two theories considered by Potter et al. can be described in terms of three kinds of possible mental events. Words activate verbal representations (V) in a lexicon. Pictures also activate mental representations at some level of specificity similar to that of lexical entries for words, and these perceptual representations for pictures are called images (I) here. Finally, meanings can be identified with conceptual representations (C) that are nonlinguistic, are common to pictures and words, and exist in a general conceptual system.

As described by Potter et al., the lexical approach to meaning assumes that V-C connections make some aspects of meaning directly available from the lexical entries. Pictures, however, activate this conceptual information only via the I-V connections between imaginal representations and the corresponding verbal representations in the lexicon. The lexical model for a simple example is represented in Figure 1A and leads to the prediction that pictures should take longer than words to access conceptual information (a) because meaning is two steps removed from images (I-V-C) and only one step from verbal representations (V-C) and (b) because access is always mediated by lexical representations, which naming tasks have shown to be less available for pictures than words. Contrary to this model, Potter et al. found that pictures can be understood as quickly as words.

The other hypothesis considered by Potter et al., the conceptual approach, assumes that meaning is only available in a common conceptual system and that both words and pictures (or their corresponding verbal and imaginal representations) have direct access to that system via V-C and I-C connections. This model is shown in Figure 1B and accounts in a straightforward manner for the results. Pictures require an extra step to activate the lexicon and are therefore named more slowly than words. Nevertheless, pictures access meaning as rapidly as words be-

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Table 1  
*Reaction Times from Potter et al. (1986) for Pictures and Words on Naming and Meaning Tasks*

| Task                            | Pictures | Words | Difference |
|---------------------------------|----------|-------|------------|
| Individual items (pretest)      |          |       |            |
| Naming                          | 752      | 534   | 218        |
| Category (yes)                  | 648      | 646   | 2          |
| Sentences (Experiments 3 and 4) |          |       |            |
| Naming                          | 990      | 806   | 184        |
| Plausibility (yes)              | 794      | 788   | 6          |

cause both are connected directly to the conceptual representations that provide the information necessary for plausibility and categorization judgments. Potter et al. concluded that their results supported the conceptual model.

A more correct conclusion, however, would be that the lexical model is not consistent with the data. The further conclusion assumes that the conceptual hypothesis is the only plausible alternative to the lexical model, which was discredited by the data. At least one other interpretation is possible, however, and a dual coding account has the added advantage of explaining these data with fewer types and smaller numbers of representations than the conceptual model.

#### Dual Coding Theory

Within dual coding theory (Paivio, 1979, 1986), meaning is explained by verbal and imaginal representations alone without appeal to abstract, conceptual representations common to pictures and words. The semantic information is itself represented in verbal or imaginal forms, and the former are in principle equally accessible by both words and pictures. That is, both verbal and imaginal representations can be directly connected to verbal representations for the names of categories, properties, and other information of the sort used in categorization and plausibility judgments. Imaginal representations become connected to verbal representations other than specific names because objects are labelled generically by category names (e.g., food, vegetable) and their properties are described verbally (e.g., can be eaten, orange). Figure 1C presents a simplified dual coding alternative to the lexical and conceptual theories of meaning considered by Potter et al.

The dual coding model is consistent with the findings in Table 1. Pictures are named more slowly than words because the former involve the extra I-V connection between the imaginal representation and the verbal representation corresponding to its name. Certain types of verbal semantic information can be retrieved as quickly for pictures as for words, however, because both words and pictures involve two steps. The first step is from the external stimulus to the internal representation of the stimulus, and the second is from the internal representation directly to the imaginal or verbal semantic information (e.g., a category name) in both cases. Many probabilistic factors determine the strengths and activation of specific connections, but associative connections between two verbal representations (e.g., carrot and food) are not necessarily faster than referential connections

between imaginal and verbal representations (e.g., an image of carrot and the word *food*).

A comparison of Figures 1B and 1C shows that an explanation of Potter et al.'s data does not require the conceptual representations of 1B. Moreover, the dual coding model is seen to contain fewer numbers and types of representations than the conceptual model, suggesting that the former might be more parsimonious, although perhaps only for an explanation of these specific data. A broad array of phenomena must be considered in any judgment about the ultimate parsimony of the two theories, and such a decision is further complicated by the fact that the conceptual model requires fewer connections as the number of semantic entities (i.e., properties, categories, etc.) increases beyond two. The reduction in connections, however, hinges on the assumption that retrieval of all semantic knowledge about pictures and words is mediated by an abstract, conceptual representation. This assumption of equal accessibility from words and pictures is already doubtful for some perceptual information (e.g., Paivio, 1978). Despite the potential in dual coding theory for equality of access from words and pictures, the theory also suggests mechanisms by which different aspects of meaning might become more closely tied to one system than the other. The linguistic or verbal system, however, is not always favored over the imaginal system. For example, size information is more accessible from pictures than words, perhaps because the unique integrative properties of the nonverbal system favor pictorial access to imaginal knowledge.

If conceptual representations are unnecessary and perhaps

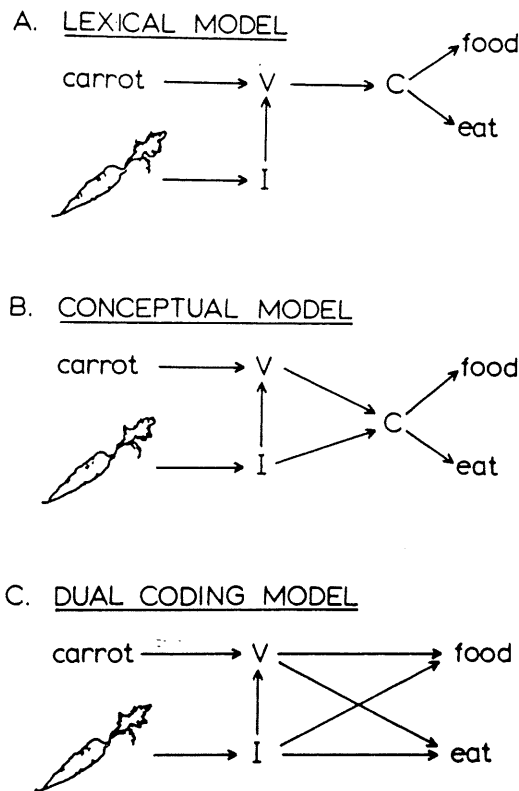


Figure 1. Lexical, conceptual, and dual coding models of picture-word processing.

even less parsimonious than the more concrete verbal and imaginal representations of dual coding theory, why are they so prevalent in cognitive psychology? Perhaps it is because they provide entities (albeit with intangible referents) to point at when asked where meanings or ideas reside in a theory. Dual coding theory avoids this nominal fallacy, however, and attributes meaning to complex patterns of activation among interconnected, less abstract, and experientially based verbal and imaginal representations.

In summary, Potter et al. demonstrated that pictures access some aspects of meaning as readily as words despite differences in their access to names. These findings are consistent with a conceptual hypothesis, but Potter et al. were explicit enough about their models and their reasoning to permit the development of a dual coding alternative that also accounts for the phenomena. The theoretical situation, therefore, is unclear and resolution of the alternative explanations must wait for more observations from the sorts of paradigms used so effectively by Potter and her colleagues. Getting from such observations to an

adequate theory of meaning is an arduous task, however, and caution at this interpretative stage may help cognitive psychology avoid the sorts of theoretical pitfalls that have been so prevalent in the history of other sciences.

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#### Cutting Appointed Editor JEP: Human Perception and Performance, 1989-1994

The Publications and Communications Board of the American Psychological Association announces the appointment of James E. Cutting, Cornell University, as editor of the *Journal of Experimental Psychology: Human Perception and Performance* for a 6-year term beginning in 1989. The current editor, William Epstein, will be receiving submissions through September 30, 1987. At that point, the 1988 volume will have been filled, and all submissions after that should be sent to James Cutting. Therefore, as of October 1, 1987, manuscripts should be directed to:

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