On disentangling and weighting kinds of semantic knowledge

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Abstract: To account for category-specific semantic deficits, Humphreys and Forde propose to fractionate semantic memory into multiple sensory and functional knowledge stores. There are reasons to doubt the empirical productivity of this proposal, unless theoretically motivated principles of distinguishing and weighting the different kinds of object knowledge can be spelled out in detail.

In order to account for category-specific semantic deficits, Humphreys and Forde (H&F) assume that different forms of sensory and functional knowledge are weighted differently in the representation of different categories of objects and that each of these knowledge forms is represented within a separated knowledge store. Our commentary focuses on this particular aspect of the Hierarchical Interactive Theory. We think further specifications are needed before this Multiple-Knowledge-Stores (MKS) account for category-specific semantic deficits could be put into the appropriate empirical test.

First, the account should make more explicit the principles that are assumed to organize knowledge in semantic memory. Unless these principles are spelled out in detail, there is no theoretically-motivated basis on which a consistent taxonomy of the different kinds of object knowledge could be drawn and the relevant tests for assessing patients' semantic knowledge be designed. There is no obvious means to relate a given property of an object to one or another kind of knowledge. How could we decide, for example, that "kangaroos move by jumping" is a property pertaining to knowledge of "biological functions," "action," or "motion" and on which basis could we assume that knowledge of this property relies on a functional/biological, functional/action or visual/motion knowledge store? The present ambiguity comes in part from the knowledge stores being equated with "perceptual recognition" stores. On one hand, this invites the interpretation that knowledge of object properties is assumed to be organized according to the sensory modality or modalities that are used to learn and transact particular objects (Tranel et al. 1997). On this interpretation, knowledge of biological functions, as well as knowledge of characteristic motion (for animate and inanimate objects) and, even, of object usage, might be considered as being heavily dependent on *visual* knowledge. On the other hand, a number of non-incidental aspects of object knowledge seemingly could not be linked uniquely or directly to a specific perceptual or motor knowledge store. We know where and how animals live, how to eat and cook vegetables, how we have to take the bus, and that we can use a kettle to boil water for tea. Such knowledge seems to require the various perceptual and motor features on which objects and actions are based being integrated within a relation specifying the specific space, event, process, or goal in which they are involved. It is unlikely that the elementary sensory and motor features that make up the vocabulary of perceptual and motor systems could suffice to represent such knowledge. Integration of features might, at the very least, require some inter-modal or supra-modal processing system. It is unclear which knowledge store, located at which hierarchical level of the proposed architecture, could achieve this goal.

Second, the account should clarify what is meant by the different forms of knowledge being *weighted* differently in the representation of different categories of objects. Weighting could be conceived of as a quantitative or a qualitative feature. In the former case, it could refer to the ratio of the number of a given kind over other kinds of properties (Farah & McClelland 1991) or to the relative prevalence of the different sensory modalities in transacting objects (Tranel et al. 1997). In the latter, one could consider the extent to which various kinds of properties are important in discriminating between two similar entities (Warrington & McCarthy 1983), the relative contribution of each kind of property in categorizing an exemplar as being or not being a given object (Malt & Johnson 1992) or the relative centrality (i.e., causal status) of different types of properties within the relational structure of the object's features (Ahn 1998). Adopting one or another view of weighting might have significant consequences. Empirical estimates based on different views did produce contrasting results. For example, Farah and McClelland (1991) found that visual properties have greater weight than functional properties for living but not for nonliving things, whereas Ahn (1998) found that both visual and functional properties could be causally central in the representation of living and nonliving things.

Hence, in its present state of specification, the MKS account does not allow to empirically derive a principled estimate of knowledge weighting across categories, which is crucially needed yet to draw new predictions about which subsets of living or/and nonliving objects could selectively be impaired, given hypothetical damage to one or another knowledge store.

Still, even such estimate were available, the cascaded and interactive processing framework of the MKS account makes it difficult to predict, without the help of a simulation, which pattern a patient with a given category-specific semantic deficit should display when answering questions about different kinds of object properties. Let us suppose, for example, that knowledge of fruit is highly dependent on color knowledge while knowledge of animals is highly dependent on shape. One could not rule out the following expectations: selective damage to the color knowledge store should impair naming of fruit and, at the same time, the retrieval of color, shape, and function of fruit, because color knowledge might also be required when answering questions about shape and function of fruit – while, for animals, naming as well as retrieving knowledge of shape, function, *and* color could be spared because, in this case, access to color knowledge might be supported by the integrity of activation from spared knowledge stores (shape and function). Hence, the question is raised whether a localised damage to such an architecture could eventually result in the pattern that is intuitively expected given selective damage to a knowledge store, that is, a selective semantic deficit for a category (e.g., fruit), associated with a *selective* impairment in accessing one kind of knowledge (color) across all categories (fruit, animals, etc.). If this intuitive prediction were shown to be wrong, then we ask the question of how evidence could be sought in a patient's performance for the hypothesis that its category-specific deficit originates from a specific knowledge store being *selectively* damaged.

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