

DOUBLE DISSOCIATIONS ON THE SAME STIMULI

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The paper adds a previously unfocused methodological problem to the long list of potentially confounding factors in category-specificity investigations. The author notes how the appropriate selection and use of a group of normal controls is essential for conducting unbiased inferences from clinical data. This control group should: i) be matched for those variables that are expected to modulate the patient's performance and ii) it must perform below ceiling. This criterion applies both to single and double dissociations.

As regards to dissociations in semantic memory disorders, Laws showed that when a control group with ceiling effect is used, then paradoxical category effects may occur across different stimulus sets (and presumably across tasks aimed at measuring the same process). A retrospective analysis of published cases showed that no one single case study examining category effects in patients compared patient's performance with data from matched controls with performance below ceiling and matched stimuli.

The problem of possible biased inferences is particularly critical in the case of supposedly double dissociations and the existence of double dissociations on the same set of stimuli has been used to constrain theories of semantic memory. A double dissociation of this kind perform in the opposite directions on the same set of stimuli. For example Hillis and Caramazza (1991) tested patients JJ and PS on a picture naming task. It is the contention of the authors that this double dissociation rules out all those factors that identify in the characteristics of the concepts the origin of category-specificity. This because the stimuli used in the two patients were the same. The existence of a double dissociation on the same set of stimuli, is therefore one of the best arguments of the *advocatus dei* when claiming that categories (e.g., Living and Non-living) are built in the brain (Hillis and Caramazza, 1991; Caramazza and Shelton, 1998).

From the existence of double dissociations on the same stimuli some theories are apparently diminished in their explanatory power. In particular we refer to those theories that claim that the origin of category-specificity relies on specific statistical characteristics of concepts. For example, Living concepts are characterised by lower levels of distinctiveness<sup>1</sup> in their constituent semantic

features (Garrad et al., 2001; Tyler and Moss, 1997), by higher levels of intercorrelation<sup>2</sup> (Devlin et al., 1997) and by lower semantic relevance<sup>3</sup> and dependency<sup>4</sup> (Sartori and Lombardi, 2004; Marques, 2002). These parameters, that describe various characteristics of semantic features, are considered to be at the base of category-specific effects in semantic memory patients. However, all these explanations, which lead back to the structure of concepts as the cause of category-specificity, struggle in accounting for double dissociations on the same stimuli. How should a factor which predicts lower performance in one direction predict, on the same stimuli, also a performance in the opposite direction?

The direction of the argumentation clearly changes when the existence of this clinical fact is questioned. And this seems to be the case after Laws. To our knowledge there are two published cases of double dissociations on the same stimuli in category-specific patients and in both cases a control group performing below ceiling was not reported (Hillis and Caramazza, 1991; Silveri et al., 1997; Sartori and Job, 1988). Therefore, applying Laws arguments, these data lack genuine supporting evidence. As he showed they may index a real double dissociation, they may index a single double dissociation, or finally they may even index a paradoxical double dissociation. The evidence is even weaker if we observe that in cases of double dissociations we may need two separate groups of controls (one for each patient) when they are not comparable for sex, education and age. Therefore we are tempted to conclude that this uncertainty renders the evidence too weak to be used as a real empirical test aimed at establishing strength of opposing theories.

<sup>2</sup> Intercorrelated features are those which are more likely to occur together than independently. As an illustration, <is a quadruped> and <has a tail> are highly correlated features while <is a quadruped> and <has a handle> are not. Considering that the amount of correlated features is larger in Living with respect to Non-living, this might be a reason for the greater vulnerability of the Living categories. By contrast, it has also been contented that a greater tendency for mutual activation between correlated feature pairs provides a source of collateral support for such features, resulting in a greater robustness in the face of damage (e.g., Devlin et al., 1997). Correlated properties have an effect in a variety of tasks including feature verification. When the presented feature is highly correlated with other features verification times are faster (McRae et al. 1997).

<sup>3</sup> Semantic relevance is a parameter indexing the importance of a semantic feature in concept identification. It is a measure of the contribution of semantic features to the "core" meaning of a concept. Semantic features with high relevance are those that are useful to distinguish the target concept from similar concepts.

<sup>4</sup> <Building nests on trees> is a semantic feature that depends on <having wings>. Living have been shown to have different dependency values in their constituent semantic features with respect to Non-living (Marques, 2001).

<sup>1</sup> Highly distinctive semantic features are those which appear in the definition of few concepts while low distinctive features appear in the definition of many concepts.

In brief, Laws' arguments, when applied retrospectively to published cases of category-specificity may change the landscape of discussion, as well as the theoretical focus on theories.

## REFERENCES

- CARAMAZZA A and SHELTON JR. Domain-specific knowledge systems in the brain: The animate-inanimate distinction. *Journal of Cognitive Neuroscience*, 10: 1-34, 1998.
- DEVLIN JT, GONNERMAN LM, ANDERSON ES and SEIDENBERG MS. Category-specific semantic deficits in focal and widespread brain damage: A computational account. *Journal of Cognitive Neuroscience*, 10: 77-94, 1998.
- GARRAD P, LAMBON RALPH M, HODGES JR and PATTERSON K. Prototypicality, distinctiveness, and intercorrelations: Analyses of the semantic attributes of living and nonliving concepts. *Cognitive Neuropsychology*, 18: 125-174, 2001.
- HILLIS AE and CARAMAZZA A. Category specific naming and comprehension impairment: A double dissociation. *Brain*, 114: 2081-2094, 1991.
- LAWS KR. 'Illusion of normality': A methodological critique of category specific-naming. *Cortex*, 41, 842-851, 2005.
- MCRAE K, DESA VR and SEIDENBERG MS. On the nature and scope of featural representation in word meaning. *Journal of Experimental Psychology, General*, 126: 99-130, 1997.
- MARQUES JF. An attribute is worth more than a category: Testing different semantic memory organisation hypotheses in relation to the living-non-living things dissociation. *Cognitive Neuropsychology*, 19: 463-478, 2002.
- SARTORI G and JOB R. The oyster with four legs: A neuropsychological study on the interaction of visual and semantic information. *Cognitive Neuropsychology*, 5: 105-132, 1988.
- SARTORI G and LOMBARDI L. Semantic relevance and semantic disorders. *Journal of Cognitive Neuroscience*, 16: 439-452, 2004.
- SILVERI MC, GAINOTTI G, PERANI D, CAPPELLETTI JY, CARBONE G and FAZIO F. Naming deficit for non-living items: Neuropsychological and PET study. *Neuropsychologia*, 35: 359-367, 1997.
- TYLER L and MOSS H. Functional properties of concepts: Studies of normal and brain damaged patients. *Cognitive Neuropsychology*, 14: 511-545, 1997.

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