

Case History Study

Selective impairment of living things and musical instruments on a verbal 'Semantic Knowledge Questionnaire' in a case of apperceptive visual agnosia

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ABSTRACT

Semantic memory was investigated in a patient (MR) affected by a severe apperceptive visual agnosia, due to an ischemic cerebral lesion, bilaterally affecting the infero-mesial parts of the temporo-occipital cortices. The study was made by means of a Semantic Knowledge Questionnaire (Laiacona, Barbarotto, Trivelli, & Capitani, 1993), which takes separately into account four categories of living beings (animals, fruits, vegetables and body parts) and of artefacts (furniture, tools, vehicles and musical instruments), does not require a visual analysis and allows to distinguish errors concerning super-ordinate categorization, perceptual features and functional/encyclopedic knowledge. When the total number of errors obtained on all the categories of living and non-living beings was considered, a non-significant trend toward a higher number of errors in living stimuli was observed. This difference, however, became significant when body parts and musical instruments were excluded from the analysis. Furthermore, the number of errors obtained on the musical instruments was similar to that obtained on the living categories of animals, fruits and vegetables and significantly higher of that obtained in the other artefact categories. This difference was still significant when familiarity, frequency of use and prototypicality of each stimulus entered into a logistic regression analysis. On the other hand, a separate analysis of errors obtained on questions exploring super-ordinate categorization, perceptual features and functional/encyclopedic attributes showed that the differences between living and non-living stimuli and between musical instruments and other artefact categories were mainly due to errors obtained on questions exploring perceptual features.

All these data are at variance with the 'domains of knowledge' hypothesis, which assumes that the breakdown of different categories of living and non-living things respects the distinction between biological entities and artefacts and support the models assuming that 'category-specific semantic disorders' are the by-product of the differential weighting that visual-perceptual and functional (or action-related) attributes have in the construction of different biological and artefacts categories.

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1. Introduction

Since their first description of patients with category-specific semantic impairments for living and for non-living things, Warrington and coworkers (Warrington & McCarthy, 1987; Warrington & Shallice, 1984) have explicitly claimed that in their patients the semantic disorders did not respect the boundaries between living/biological entities and non-living/artefact items. In particular, they noticed that the representation of 'body parts' tends to be disrupted in association with that of the artefact categories, whereas

the representation of 'musical instruments' tends to be disrupted with that of biological entities. This observation was consistent with the 'sensory-functional theory' advanced by Warrington and coworkers to explain the living/non-living distinction. According to this theory, 'category-specific semantic disorders' are not due to the disruption of true 'biological' and 'artefact' categories, but are rather the by-product of a more basic dichotomy, concerning the differential weighting that visual-perceptual and functional attributes have in the construction of biological and, respectively, of artefacts categories. According to this interpretation, identification of a particular exemplar of a living category relies crucially on visual-perceptual features, whereas identification of a of man-made artefact depends critically on functional attributes. Within this framework, musical instruments (on which our attention will be focused) should be regarded as more similar to 'living' items,

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because musical instruments are not recognized by their function, but by their different shape and acoustic features. On the other hand, body parts should be associated with artefacts because the ‘sources of knowledge’ that critically contribute to the construction of this category are the somato-sensory and the action-related information that also play a critical role in the development of tools and other artefact categories (Gainotti, Ciaraffa, Silveri, & Marra, 2009).

Empirical data in support of this interpretation have been provided by Basso, Capitani, and Laiacona (1988), Damasio (1990), Stewart, Parkin, and Hunkin (1992), Breedin, Saffran, and Coslett (1994), Farah, Meyer, and McMullen (1996), Silveri and Gainotti (1988) and Dixon, Piskopos, and Schweizer (2000), who have reported patients with category-specific defects for living things where the performance with musical instruments was equivalent or even lower than that obtained with living items. Furthermore, these clinical data have been confirmed by experiments conducted with a neural network model (Gales, Done, & Frank, 2001), in which living things and musical instruments elicited greater recognition failures relative to other categories.

A very different theoretical viewpoint about the nature of category-specific semantic disorders has been taken in the following years by Caramazza, coworkers (Caramazza, 1998; Caramazza & Mahon, 2003; Caramazza & Shelton, 1998), who have proposed the notion of an ‘innate’ categorical organization of conceptual knowledge, which posits that category-specific impairments for animals, plant life and artefacts reflect an innate categorical organization of neural networks, shaped by natural selection to support rapid identification of objects very relevant for survival.

Within this different framework, the reports of patients showing defective performances both with living items and with musical instruments have been considered as spurious and due to the influence of unmatched “nuisance” variables, such as familiarity, age of acquisition and lexical frequency (Barbarotto, Capitani, & Laiacona, 2001; Capitani, Laiacona, Mahon, & Caramazza, 2003). This interpretation, however, is at variance with data reported by Dixon et al. (2000) who, have confirmed the particular status of musical instruments, using lists of living beings, artefacts and musical instruments well controlled for frequency, stimulus complexity and familiarity.

Since the problem remains controversial and is important from the theoretical point of view, we will describe here the case of a subject affected by an ischaemic stroke involving bilaterally the territory of the posterior cerebral artery, because this patient, who presented with neuropsychological features of a visual agnosia

syndrome, showed on a verbal ‘Semantic Knowledge Questionnaire’ (Laiacona et al., 1993) a selective impairment of living things and musical instruments.

2. Materials and methods

2.1. The patient

Twenty days before the present investigation, M.R., a 72-year-old, right-handed Vatican soldier employed on police duties suffered from an ischemic stroke.

In the following days the patient complained about an inability to “see” objects, watch television or read newspapers. Dressing as well as other activities of daily living could be carried out on his own only when he knew exactly beforehand where respective objects were located in the room. Otherwise he was unable to visually identify and find the wanted items. Identification of objects by their characteristics such as smell or taste was still possible. He had some difficulties in space orientation in the hospital ward and specific difficulties in recognizing his own bed in the ward.

Ophthalmological investigation did not detect any disorder of the peripheral visual system. Clinical neurological testing revealed neither paresis nor sensory disorders and no visual field deficits. Testing for optic ataxia was controlled by two investigators one sitting in front of the patient, the other standing behind him. M.R. fixated the nose of the investigator sitting in front of him and grasped a target object that was presented by the second investigator at various locations in the left and right visual half field. Ten reaches were tested for both hands separately. No reaching error was observed.

The patient underwent a brain-MRI (Fig. 1) which showed an ischemic cerebral lesion, bilaterally affecting the infero-mesial parts of the temporo-occipital cortices (fusiform and para-hippocampal gyri), with a prevalence on the left side and sparing of the primary visual cortex.

The patient was discharged with a diagnosis of: Bilateral ischemic stroke in the territory of the Posterior Cerebral Arteries. A cognitive neurorehabilitation was prescribed.

2.2. General neuropsychological assessment

M.R. has been evaluated by means of a standardized neuropsychological battery constituted by different cognitive tasks specifically aimed at the examination of distinct cognitive domains

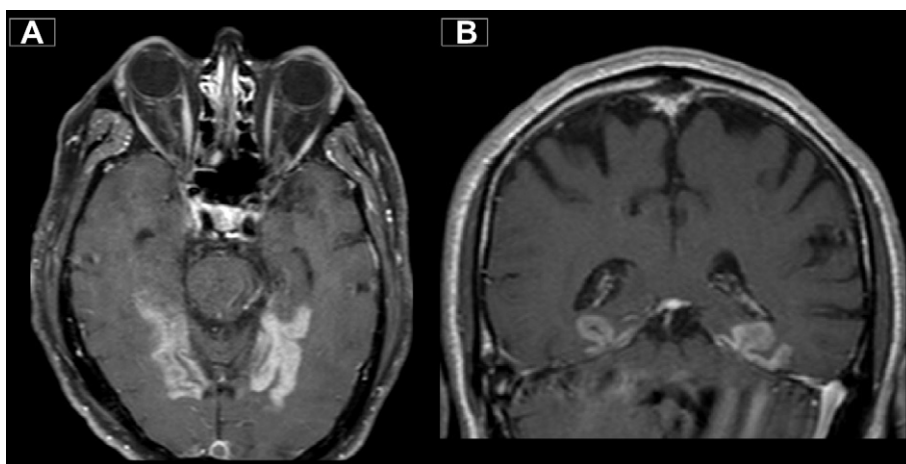


Fig. 1. Trasversal (A) and coronal (B) MRI sections of MR lesion. The lesion involves the parahippocampal and fusiform gyri bilaterally and slightly asymmetrically (left > right). Calcarine cortex and temporal poles are bilaterally spared.

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