

Animals and Artifacts May Not Be Treated Equally: Differentiating Strong and Weak Forms of Category-Specific Visual Agnosia

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We examined a categorical dissociation hypothesis of category-specific agnosia using hierarchical regression to predict the naming responses of three agnosia patients while controlling a wide variety of perceptual and conceptual between-category differences. The living–nonliving distinction remained a significant predictor for two of the patients after controlling for all the other factors. For one remaining patient, the categorical variable was not significant once the form–function correlation of different objects was controlled. We argue that the visual system may use various subprocesses at different stages, some of which reflect true categorical organization and some of which reflect a unitary feature-based system that distinguishes kinds.

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In recent years, case studies of brain-injured patients have demonstrated a selective impairment in recognizing objects in a specific category. The most prevalent pattern of this deficit is difficulty in recognizing living things while recognition of nonliving things is preserved (Basso, Capitani, & Laiacina, 1988; De Renzi & Lucchelli, 1994; Farah, McMullen, & Meyer, 1991; Hart & Gordon, 1992; Hillis & Caramazza, 1991; Sartori, Miozzo, & Job, 1993; Arguin, Bub, & Dudek, 1996). However, the opposite pattern, a deficit in recognizing nonliving objects with intact recognition of living objects, has been also reported (Hillis & Caramazza, 1991; Sacchett & Humphreys, 1992; Warrington & McCarthy, 1983, 1987, 1994).

Although many studies have provided evidence for the existence of category-specific visual agnosia (CSVA), its interpretation is still in debate. Some authors have argued that CSVA is an artifact of uncontrolled differences between categories of stimulus items used to test for these deficits. Others have argued that the deficit is more substantive and have suggested a number of alternatives ranging from the hypothesis that the deficit reflects between-category differences in the centrality of subtle visual cues to the hypothesis that the deficit reflects a true neural specialization for visual processing of different kinds. Here, we review these alternatives and present a hierarchical logistic regression analysis of three patients' naming responses for the

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Snodgrass and Vanderwart (1980) stimulus set. Our aim is to test for a categorical deficit after controlling for many of the factors hypothesized to account for CSVA, including simple perceptual factors such as contour rectilinearity and conceptual variables such as visual form–function correlations. In addition, we broaden the analysis to include performance data of normal subjects in a visual search task for each of the Snodgrass and Vanderwart images. By doing so, we hope to capture between-category differences in the degree to which simple or complex visual features specify membership in artifact and natural kind categories.

CSVA: Methodological Objections, Alternative Explanations, and Categorical Foundations

Following the initial reports of categorical deficits, some researchers have pointed out there may be methodological problems in these studies. Most important, the category-specific effect may be an artifact of the failure to control for factors which influence naming. For instance, a patient may have more difficulty naming a particular set of animals if they contain less familiar items than the artifact set. Funnel and Sheridan (1992) have shown that the category-specific effect in picture naming could disappear after carefully matching items for familiarity, and Stewart, Parkin, and Hunkin (1992) demonstrated that the category-specific effect for an agnosia patient disappeared after controlling for word frequency, concept familiarity, and visual complexity. Additionally, Gaffan and Heywood (1993) showed that normal subjects could make similar naming errors as agnosics if the visual image was presented briefly with low contrast and that the errors were more common for living items than nonliving items. They concluded that the higher visual similarity among living objects can explain naming performance of the patients. On the other hand, Sartori, Miozzo, and Job (1993) have shown that their patient, Michelangelo, still had a selective impairment in naming living objects after test items were matched for familiarity, complexity, name frequency, and similarity. Therefore, although factors such as familiarity and complexity may influence naming performance, it seems unlikely that they can explain all instances of CSVA.

While the category effect may be real, interpretations of the phenomenon vary. Some researchers have suggested that these selective recognition deficits are due to an impairment in processing a particular type of feature. Warrington and her colleagues (Warrington & McCarthy, 1983, 1987; Warrington & Shallice, 1984) have proposed that living and nonliving objects are defined in fundamentally different ways (Sensory-Functional Feature theory). For living objects, sensory features are essential in defining the object, whereas functional features are essential for nonliving objects. Although this theory proposes that the living–nonliving dissociation is feature-based, it does assume multiple neuroanatomically distinct systems that process either sensory or functional features of an object. Recent findings from priming studies in normal subjects lend support to this hypothesis by suggesting that priming of functional features of objects is segregated from priming visual nonfunctional features (Thompson-Schill & Gabrieli, 1999). In support of the Sensory-Functional Feature theory, the deficit in recognizing living objects has been associated with the temporal damage while the deficit with artifacts has been associated with the frontoparietal damage (Saffran & Schwartz, 1994). Additionally, imaging studies with normal subjects have shown that distinct neural areas are involved in the naming of animals and tools with activation in the left inferior frontal area unique to tools (e.g., Martin, Wiggs, Ungerleider, & Haxby, 1996). This account can also explain why the living deficit is often accompanied by musical instrument and vehicle deficit (Saffran &

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