



## Note

# Gender differences in category-specificity do not reflect innate dispositions



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## ABSTRACT

It is well established that certain categories of objects are processed more efficiently than others in specific tasks; a phenomenon known as *category-specificity* in perceptual and conceptual processing. In the last two decades there have also been several reports of gender differences in category-specificity. In the present experiments we test the proposition that such gender differences have an evolutionary origin. If they do, we would expect them to emerge even when the population tested comprises young individuals raised in a gender-equality oriented society. Contrary to this expectation we find no evidence of gender differences in category-specificity in a relatively large sample ( $N = 366$ ) drawn from such a population; and this despite the fact that both tasks applied (object decision and superordinate categorization) gave rise to reliable category-effects. We suggest that a plausible account of this discrepancy is that previous reports of gender differences may have reflected differences in familiarity originating from socially-based gender roles.

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## 1. Introduction

The functional organization of conceptual knowledge has been a central topic in cognitive neuroscience since Warrington in 1975 described the first cases of selective semantic impairments in patients with brain injury. This report was followed by neuropsychological studies suggesting that semantic memory could even be affected in a category-specific manner, so that comprehension of artefacts could be relatively preserved compared with comprehension of biological entities or vice versa (e.g., Hillis & Caramazza, 1991; Sartori &

Job, 1988; Silveri & Gainotti, 1988; Warrington & McCarthy, 1983, 1987; Warrington & Shallice, 1984; for reviews see Capitani, Laiacona, Mahon, & Caramazza, 2003; Gainotti, 2000). Furthermore, ensuing investigations showed that within the broad class of biological objects, semantic disorders can selectively disrupt the comprehension of fruits and vegetables (e.g., Forde, Francis, Riddoch, Humphreys, 1997; Hart, Berndt, & Caramazza, 1985; Samson & Pillon, 2003; for reviews see Capitani et al., 2009; Gainotti, 2005, 2010) or animals (e.g., Caramazza & Shelton, 1998; Hart & Gordon, 1992; for reviews see Capitani et al., 2009; Gainotti, 2005).

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While the existence of category-specific disorders is well established, there is no consensus regarding their explanation (Gainotti, 2015). Indeed, there seem to be two general positions with a respectively Platonic and Aristotelian legacy; the rationalistic position which stresses that category-specific impairments basically reflects innate constraints on conceptual knowledge, and the empiricist position, which stresses that category-specific impairments stem from the fact that the organization of knowledge is a product of experience. The main proponents of an innate position are Caramazza and Shelton (1998) who proposed "... that evolutionary pressures have resulted in specialized mechanisms for perceptually and conceptually distinguishing animate and inanimate kinds ..., leading to a categorical organization of this knowledge in the brain" (p. 9). More specifically, these authors suggested that dedicated neural mechanisms, developed under evolutionary pressure, could subserve different 'domains of knowledge', which play a very important role in human survival. These domains of knowledge could concern 'animals' (potential predators), 'plant life' (possible source of foods and medicine), 'body parts' and 'artefacts'. On the other hand, the empiricist position, which can be considered as a development of the 'differential weighting hypothesis', proposed by Warrington and McCarthy (1983) and Warrington and Shallice (1984), maintains that different kinds of sensory-motor and functional sources of knowledge could play different roles in the comprehension of various kinds of living and non-living categories. These theoretical accounts of category-specificity were further developed by Mahon and Caramazza (2011), and by Chen and Rogers (2014). The former argued that there are innately determined patterns of connectivity that mediate the integration of information from the ventral stream with information computed by other brain regions and that the specialization by semantic category in the ventral stream is driven by that connectivity. The latter reviewed evidence supporting the view that category-specificity arises from many heterogeneous factors, and that apparent category-specific patterns cannot be interpreted on the basis of the Warrington and Shallice's (1984) sensory/functional theory, but actually reflect differential reliance on different kinds of sensory, motor, linguistic, and affective information (e.g., Gainotti, Spinelli, Scaricamazza, & Marra, 2013a; Hoffman & Lambon Ralph, 2013). According to this view, category-specificity should tell us little directly about the cognitive and neural architecture of semantic memory.

Entwined with the controversy regarding whether the organization of conceptual knowledge is primarily a product of nature or nurture is the issue of gender differences in category-specificity. Theoretically, it must be admitted that if the organization of conceptual knowledge is a product of innate constraints, and if evolution has led to gender differences in division of labor related to these constraints (Laiacina, Barbarotto, & Capitani, 2006; Silverman & Eals, 1992), it seems reasonable to expect gender differences in conceptual processing of certain categories of objects. Also, from a factual standpoint, both data from category-specific semantic disorders and from experimental investigations in healthy subjects suggest, indeed, an interaction between gender and category-specificity. Results obtained in patients with category-specific semantic disorders have been summarized by Gainotti (2005), who showed that in patients with category-specific impairments for biological

entities, men were systematically more impaired with plant life categories and women were usually more impaired with animals. Data obtained in healthy subjects are generally consistent with those observed in patients with category-specific disorders, because they have shown that men are more familiar, and obtain better performances, with artefacts and animals, whereas women are more familiar and proficient with fruits and vegetables. We briefly describe these findings below, limiting the scope to those reported with neurologically intact subjects, as this is the main topic of the present paper.

Gender-related asymmetries in category-specificity have been observed in naming tasks from adults and children (McKenna & Parry, 1994), in familiarity ratings (Albanese, Capitani, Barbarotto, & Laiacina, 2000), and in age of acquisition of common names (Barbarotto, Laiacina, & Capitani, 2008). Similar asymmetries have been found on speeded naming (Laws, 1999) and identification (Laws, 2000) tasks, on name-generation tasks (Laws, 2004), on semantic fluency tasks (Cameron, Wambaugh, & Mauszycki, 2008; Capitani, Laiacina, & Barbarotto, 1999; Marra, Ferraccioli, & Gainotti, 2007), and on object decision tasks (ODTs) (Barbarotto, Laiacina, Macchi, & Capitani, 2002). As for the gender-related differences in processing of biological versus artefact categories, most authors (e.g., Barbarotto et al., 2008; Capitani et al., 1999; Laws, 1999, 2000, 2004) report that males are more proficient with artefacts, and females with biological stimuli. Laws (1999), for instance, reported a significant interaction between gender and category in picture naming with males being faster at naming non-living things, and females being faster at naming living things. A similar pattern was found in a picture-naming task using a naming-to-deadline paradigm (Laws, 2000), and by Barbarotto et al. (2008) who found a male advantage for naming 'Tools' and a female advantage for naming 'Fruit'. As for the investigations of male and female performance within the biological categories, several studies have shown that men are more proficient with 'animals' and women with 'fruit' and 'vegetables' (Albanese et al., 2000; Barbarotto et al., 2002; Cameron et al., 2008; Capitani et al., 1999; Laws, 2004; McKenna & Parry, 1994; Moreno-Martinez, Laws, & Schulz, 2008).

An 'innate' interpretation of the gender asymmetries was offered by Laws (2000, 2004) who suggested that a greater development of brain circuits dealing with tools and animals in men, and with fruits and vegetables in women, could be a product of the main subsistence activities of men (hunting) and women (gathering). Refining this line of thought, Laiacina et al. (2006), proposed that the evolutionary pressures, which prompted the development of different brain networks dedicated to animals and plant life, might also have provided each gender with more efficient cognitive representations of their main foraging targets (i.e., animals for men and fruits and vegetables for women). A different, and experience-dependent, interpretation of gender asymmetries was proposed by Gainotti (2005, 2010). He suggested that only the distinction between living and non-living things reflects an inborn anatomically-based categorical organization, whereas the asymmetry (within living entities) between animals and plant life might be due to familiarity factors related to social roles, namely to men's greater familiarity with animals and women's with fruits and vegetables. The hypothesis that gender asymmetries may be experience-dependent is

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