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Warrington and Taylor's 1978 paper

[Warrington E K, Taylor A M, 1978 "Two categorical stages of object recognition" *Perception* **7** 695 – 705. Original paper reprinted in the appendix.]

Comments

Multiple representations for perceptual categorisation

The distinction made in Warrington and Taylor (1978) between perceptual and semantic categorisation has been widely accepted in subsequent models of object and face recognition (Humphreys and Bruce 1987). Indeed, as Warrington makes clear in her commentary (this supplement), the origins of the idea go back to Lissauer (1890). A similar serial sequence is also to be found in the work of Posner and his colleagues (Posner 1969; Posner and Keele 1967) that has also been confirmed in subsequent studies (Bartram 1976; Ellis and Allport 1986; Lawson and Humphreys 1996). However, describing the first of Warrington's categorical stages (perceptual categorisation) has turned out to be a more complicated matter than was presumed in 1978 (see also Warrington's commentary).

There is an ongoing debate between two groups of theories of how the visual system achieves view invariance and object constancy. One major account, which will be referred to as image-based or view-based, proposes that representations mediating object recognition are based on stored views or metric templates (eg Bülthoff and Edelman 1992; Lowe 1987; Poggio and Edelman 1990; Tarr and Pinker 1989; Ullman 1989). Since a visual representation is determined by view familiarity, the sensitivity of the visual system to view changes can be readily explained in image-based accounts. In contrast, so-called structural description theories, which will be referred to as part-based representations, assume that the visual system extracts a more abstract representation by encoding an object's constituent parts and their relation (eg Biederman 1987; Dickinson et al 1997; Marr 1982). These more abstract representations are attractive to those looking for parsimonious accounts of object constancy.

Much of the debate on perceptual categorisation in the 20 years following the publication of the Warrington and Taylor paper has concerned attempts to show that only one of the two major accounts is necessary for perceptual categorisation. More recently, there have been several attempts to reconcile the two approaches. For example, Tarr and Bülthoff (1995) proposed that use of the types of representation depended on task demands. Extreme cases of within-class discrimination allow for recognition exclusively achieved by image-based mechanisms. However, when objects are to be distinguished in broad categorical classes, recognition may be exclusively achieved by part-based mechanisms. An alternative hybrid approach has come from the work of Hummel and his colleagues (Stankiewicz and Hummel 2002; Stankiewicz et al 1998). Hummel et al have argued that the part-based representations can only be accessed from attentional mechanisms, whereas view-based representations have automatic access. Recent work has confirmed their findings with a wide variety of stimuli (Thoma and Davidoff 2006; Thoma et al 2004, 2005). Warrington in subsequent work has examined how the perceptual-categorisation stage may be fractionated (see her commentary) and the nature of the representation that might serve as access to semantic categorisation (Davidoff and Warrington 1999, 2001; Warrington and Davidoff 2000). In particular, her work has been concerned with describing the minimal ('barebones') or canonical representation that would access left-hemisphere knowledge structures.

The aspects of hemispheric specialisation in Warrington and Taylor has been taken up by Kosslyn and his colleagues (Kosslyn et al 1989, 1992) with subsystems specialised for metric and coordinate relations. Another recent account based on hemispheric differences comes from Marsolek (1999). He proposed that the human visual system draws on two different subsystems in order to resolve contradictory demands of subordinate and superordinate classification of objects. An abstract-category recognition system, which is assumed to be dominant in the left brain hemisphere, serves the ability to generalise across different exemplars of an object category. A second subsystem (the specific-exemplar subsystem) is thought to be working more effectively in the right hemisphere

and maps even slightly different shape exemplars to different output representations. Marsolek's ideas are very easy to trace back to ideas in Warrington and Taylor; however, the huge citation list for the paper shows that it was not only Marr (1982) that found inspiration in the work.

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