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Paradoxical configuration effects for faces and objects in prosopagnosia

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Abstract

Selective impairment in recognition of faces (prosopagnosia) has been advanced as an argument for a brain module dedicated to face processing and focusing on the specific configural properties of faces. Loss of the inversion effect supposedly strengthened the argument ([10]: de Gelder B, Bachoud-Levi AC, Degos JD. Inversion superiority in visual agnosia may be common to a variety of orientation polarised objects besides faces. Vision Research, 1998;38:2855–61; [20]: Farah MJ, Wilson K, Drain H, Tanaka J. The inverted face inversion effect in prosopagnosia: Evidence for mandatory, face-specific perceptual mechanisms. Vision Research 1995b;35:2089–93). The present study of prosopagnosic patient LH reports that he has lost the normal pattern of superior performance with upright faces and objects and shows instead paradoxical inversion effect for faces but also for objects. Experiment 2 investigated whether LH's use of features based route for processing upright objects would be hindered by the whole-based encoding when processing upright objects. The data show the same context effect for objects as was found for faces. Therefore the inversion effect does not present decisive evidence for the existence of a face module. Moreover, the importance of configuration-based recognition known to be crucial for face processing, must also be taken seriously for object recognition.

Keywords: Object perception; Face perception; Visual agnosia; Prosopagnosia; Inversion effect

1. Introduction

Two contrasting views of the relation between disorders of visual object recognition (visual object agnosia) and face recognition (either in the narrow or the wide sense of prosopagnosia) are currently pursued with a variety of research methods. The search for neuroanatomical substrates special to faces was the topic of animal studies using single cell recording in the temporal cortex ([35], but see [24]) and continues with recent fMRI and ERP studies (e.g. [25–27]). At the core of the debates in neuropsychology is the question whether prosopagnosia reflects the existence of an autonomous processing system possibly based on a hard-wired face module (e.g. [19,20]). Support for the view that faces are unique perceptual stimuli has been provided by studies of patients with brain damage that have established material specific dissociations (for recent studies see Refs. [17,19,23,31]). In the literature on normal face processing arguments in favor of a specialized face processor are related to special effects obtained in studies of face processing. These include the inversion effect and the face context effect, both explained by reference to the stimulus configuration in the sense of the relation between the parts of a stimulus [1,8,13,37] and special processing strategies like holistic encoding [21]. An alternative view challenges the idea of a radical dissociation between a processing

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route for faces and a separate one for other visual objects. Prosopagnosia thus appears as an extreme manifestation of damage to the object recognition system. For example, prosopagnosia has been interpreted as a problem in discriminating highly resembling items [6,7,33], as when within = category discrimination is required (see also [28]). A similar prediction is that specific patterns of performance (like the inversion effect or the context effect) found in studies of face recognition also obtain in object perception given the right control stimuli and task demands [10].

The best known example of a characteristic pattern of performance linked to the nature of the visual stimulus is the inversion effect (the relative loss of performance with inverted as contrasted to upright faces). Yin [40] showed that upside-down presentation affected recognition performance for faces but much less so for other mono-oriented stimuli such as houses. In a follow up study Yin [41] asked whether brain damage in areas thought to be critical for face recognition would have a negative impact on the preferential treatment of upright faces. He observed that right posterior brain damage eliminated the normal inversion effect. This finding fueled the idea that the inversion effect presents a benchmark of normal face processing and subsequently the inversion effect is absent after the loss of face recognition abilities in adulthood.

Pursuing Yin's idea Farah and collaborators [20] studied the inversion effect in a prosopagnosic patient LH expecting that this effect would have disappeared. They reached a very different conclusion since the patient was actually better at matching upside-down faces. In an effort to explain this puzzling result the authors argued that it is due to a continuing interference from an impaired but still active face processor, and therefore constitutes conclusive evidence (an 'existence proof') for a face module. There are two major problems with this conclusion. The first problem for such a strong modularist conclusion concerns the relation between face and object processing, and the absence of an appropriate control task for fully intact object processing. The second is that this conclusion is too broad and leaves entirely open what the pattern of spared and intact aspects of the face processor might be.

As a matter of fact, the study by Farah et al. reached somewhat strong conclusions given that it did not use objects as a control stimuli with an exemplar level recognition task [6,7]. It is well known that the inversion effect, though normally strongest with faces, has also been found with objects. Inversion effects have been reported for visual materials like handwriting [3] and gundogs, but not landscapes or houses [13]. A recent study by Donnelly and Davidoff [14] used houses and scrambled houses and found clear evidence for the importance of configuration in object recognition. The relevance of the appropriate comparison was brought home by a recent study reporting that patient AD suffering from visual object agnosia and prosopagnosia showed an inversion superiority effect not only for faces but also for objects [10]. The object category selected for the comparison with faces in this study were shoes. Like faces, shoes have a similar shape and are found in many exemplars. Shoes were also chosen because they had two characteristics that allowed to maximize similarity between the object and face task. Like faces, shoes have a canonical orientation, a relevant property for studying the face inversion effect. Moreover, often in daily life visual search is aimed at recognition at the exemplar level, as is the case in face recognition.

In this study our goal was to investigate patient LH who unlike patient AD was known to be agnosic only for faces [30]. Therefore we expected to find a clear dissociation between his performance for face and object stimuli equated otherwise for task and level of recognition. It is worth noting though that a recent study of LH mentions without further detail that this patient does have some problems in the domain of object and animal recognition [16]. But since this patient is considered in the literature as a particularly good case of prosopagnosia [16,19,20] our prediction was that LH would show the paradoxical pattern of better performance with upsidedown stimuli only for faces and not for objects. Such an outcome would be in line with the strong assumptions about face modularity encountered in the study by Farah et al. But if there is a similar impairment for faces and objects the radical explanations of face modularity would not be supported. In contrast, such an outcome would be consistent with theories that envisage a stage or a separable dimension of visual processing related to the overall orientation and configuration of both object and face stimuli. It might even be hypothesized that influence of configuration needs to be studied in the light of external factors such as memory involvement, expertise, and similar exemplar recognition rather than stimulus class [13,22,32].

The second problem with the idea of inhibition from an impaired face processor is that the notion of a face processor seems too general and opaque to be helpful in sorting out which aspects of face processing are lost and which ones are still intact and thus for understanding which intact aspects if any inhibit which others. For example, an explanation for inversion superiority envisaged by Farah and collaborators is holistic processing or the notion that in face processing the face as a whole is stored and that individual parts are not coded separately [21]. The finding