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FACE PERCEPTION AND WITHIN-CATEGORY DISCRIMINATION IN PROSOPAGNOSIA

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Abstract—Prosopagnosics are impaired at face recognition, but unimpaired, or relatively less impaired, at common object recognition. It has been suggested that this dissociation results simply from the greater difficulty of face recognition compared to object recognition, or from the greater need to discriminate visually similar members of a single category in face recognition compared to object recognition. We tested these hypotheses using the performance of normal subjects in an 'old/new' recognition paradigm to establish the true relative difficulty of face and object recognition, and required both normal subjects and a prosopagnosic subject to discriminate both faces and visually similar exemplars of nonface object categories. In two different experiments, the prosopagnosic patient performed disproportionately poorly with faces. These results disconfirm the hypotheses described above, and imply that prosopagnosia is an impairment of a specialized form of visual recognition that is necessary for face recognition and is not necessary, or less necessary, for the recognition of common objects.

Key Words: prosopagnosia; face recognition.

INTRODUCTION

When Bodamer [3] introduced the term *prosopagnosia* (face agnosia) in reporting a series of patients with impaired recognition of faces, he was highlighting the selectivity of the disorder for faces as opposed to other types of object. Many other clinicians, working before and since Bodamer's classic paper was published, have also been struck by the apparent selectivity of prosopagnosia for faces. Prosopagnosic patients may be unable to recognize even their closest family members by vision alone, and some anecdotes tell of patients who confuse their reflection in a mirror for another person [e.g. 19]. Yet many such patients evince little or no difficulty with everyday object recognition, and may retain effectively normal visual word recognition ability. De Renzi [9] reported a severely prosopagnosic patient who easily performed a variety of subtle visual recognition tasks with objects such as wallets, neckties and photographs of cats.

Despite these persuasive observations of prosopagnosics' particular difficulty with face recognition, several leading neuropsychologists have questioned the selectivity of prosopagnosia [4, 6, 7, 16, 19]. They have argued that face recognition is simply the most difficult or taxing perceptual task we routinely encounter, and a mild generalized disorder of object perception will therefore be manifest mainly during face recognition.

A related account has been put forward by Damasia and co-workers [e.g. 6–8]. According

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to these authors, prosopagnosia is not specific to faces, but more generally affects the discrimination of visually similar members of homogeneous categories. In Damasio's words, "When face agnosics must recognize nonface entities as unique individuals, for example their own pets, houses or cars, their failure is generally as marked as it is for unique faces" ([7] p. 96).

To summarize, prosopagnosia has been interpreted in two general ways, which have different implications for the architecture of normal visual object recognition. On the one hand, prosopagnosia seems limited to, or at least disproportionately severe for, faces. Whereas patients may have some accompanying impairment for the recognition of other types of stimulus object, it appears to many observers to be less severe than the face recognition impairment. If this is true, it implies that the visual system does not recognize all types of visual stimuli in the same way. Rather, it implies that there is a specialized mechanism, which is essential for face recognition and not for other types of object recognition. On the other hand, it is possible that the appearance of selectivity in prosopagnosia is just the result of poorly controlled testing, such that the difficulty, or the within-category subtlety, of the discriminations required for nonface recognition have been less than for face recognition. If this is true, then we need not postulate distinct mechanisms for face recognition; a single, general-purpose object recognition system will suffice.

The question of whether prosopagnosics have disproportionate difficulty with face recognition is a straightforwardly empirical issue, and one which has direct implications for the functional organization of normal vision. It is therefore surprising that so few direct empirical tests have been undertaken. Although the finding that prosopagnosics are impaired at nonface recognition and discrimination tasks tells us that faces are not the only stimulus category affected in these patients, this finding is ambiguous for two reasons. First, it is not uncommon for brain-damaged patients to sustain damage to multiple functional systems. Second, without knowing the relative difficulty of the face and nonface objects for normal subjects, we cannot know whether a patient is or is not *disproportionately* impaired at face recognition relative to nonface recognition. The problem of measuring relative difficulty for normal subjects is complicated by the fact that normal subjects will likely perform nearly perfectly on both face and nonface recognition tasks. The resultant ceiling effect will mask any differences in difficulty that might exist between tasks, making it pointless to test normal subjects in the kinds of recognition tasks that have traditionally been administered to patients.

One study which succeeded in assessing the relative difficulty of face and nonface stimuli was recently reported by McNeil and Warrington [18]. They studied a prosopagnosic who had become proficient at recognizing sheep faces, and compared his ability to learn the names of new human and sheep faces with normal subjects' abilities for the stimuli. Although normal subjects found the sheep harder to learn, the prosopagnosic showed the opposite pattern. This result demonstrates a high degree of selectivity for the prosopagnosic deficit.

In the present study, originally submitted for publication before the appearance of McNeil and Warrington's article, we took a similar approach to the problem of assessing the difficulty of face and nonface objects. We, too, turned to a new learning paradigm in order to set normal performance at a moderate level, intermediate between perfect performance and chance performance. The performance of a prosopagnosic patient on face and nonface stimuli was then assessed relative to normal performance with the same stimuli, so that the question of whether he is disproportionately impaired at faces could be answered.

Specifically, we employed a recognition memory paradigm with new faces and nonface

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