COVERT MATCHING OF UNFAMILIAR FACES IN A CASE OF PROSOPAGNOSIA: AN ERP STUDY

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Abstract

In addition to their deficit in overt face recognition, patients with prosopagnosia also have difficulties in matching sequentially presented unfamiliar faces. Here we assessed the possibility that covert matching of faces was present in a case with prosopagnosia using event-related potentials (ERPs). The participants (patient FE and normal controls) were challenged with a face-identity matching task, in which they decided whether two sequentially presented photographs of unfamiliar faces represented the same person. Only internal face features were used and the two faces in a pair differed in emotional expression. FE failed to overtly match these stimuli. In contrast, the ERPs revealed evidence of covert matching. If the two faces within a pair of stimuli depicted different posers, then the response to the second face contained an enhanced N300 compared to the situation where the identity of the faces was the same. The latency of the N300 was the same as a similar component found in controls. These results suggest that some cases with prosopagnosia have a covert ability to match unfamiliar faces, with similar temporal dynamics as controls, which in contrast with the idea that a generalized slowing of face processing occurs in all cases of prosopagnosia.

Key words: faces, covert matching, ERPs, prosopagnosia

Introduction

Prosopagnosia is a striking syndrome in which the ability to identify individual faces is lost due to brain injury (Bodamer, 1947). A face can be distinguished from other objects (it is not a general agnosia), and people can be identified by other means such as their voice (it is not an amnesia for individuals). The injury can be relatively restricted within the cortex. The highly selective nature of the disorder, and the fact that circumscribed lesions can cause it, suggests that face perception is segregated within the cortex. Prosopagnosia is a heterogeneous disorder (Damasio et al., 1990, De Renzi et al., 1991), with some patients having difficulties at a more perceptual level and other cases showing impairments in memory for faces, suggesting that perceptual and associative subtypes should be distinguished. The explanation of this, and other material specific agnosias, is important for theories of visual perception.

Attempts have been made to identify the mental operations that are hampered in prosopagnosia by referring to models of face processing. In the model presented by Bruce and Young (1986), a common stage of structural analysis (where face features and their configuration are extracted), is followed by at least three separate streams of processing. These streams enable either identity

recognition for familiar faces, judgments on general characteristics of the face (such as age, sex and race, also known as visual semantic codes), or recognition of emotional expressions respectively. The first requires familiarity, whereas the latter two can be performed even on unfamiliar faces.

Based on this account Burton et al. (1991) developed a computational model in which each known face is stored in a face recognition unit (FRU), which is linked to a person identity node (PIN) whose activation elicits familiarity. Similarly, there are name recognition units (NRUs) connected independently to the PINs. The PINs give access to information stored about each person in a semantic information unit (SIU). The deficit in prosopagnosia has been simulated as a partial disconnection between FRUs and PINs, and thus a weakened sense of familiarity in the presence of faces that should be remembered (Burton et al., 1991, see Young and Burton, 1999 for a detailed revision). A disconnection of this kind seems consistent with the apparently preserved ability of some prosopagnosic patients to match two unfamiliar faces, or to perform other judgments on unfamiliar faces (Benton and Van Allen, 1972, Malone et al., 1982), which could be based on the processing routes not dependent on FRUs.

In contrast, it has been argued that prosopagnosia always originates from damage to early perceptual processing (Farah et al., 1993), and that a closer examination of all patients with prosopagnosia will reveal deficits in the processing of both familiar and unfamiliar faces. The deficit may show up as prolonged times to perform tasks in the presence of mild accuracy deficits (Shuttleworth et al., 1982; Farah, 1990). Previous studies, in which processing of unfamiliar faces was assessed without time pressure, would therefore not reveal the underlying impairment to its full extent.

This alternative hypothesis has also been simulated in a computational model (Farah et al., 1993; see also O'Reilly and Farah, 1999). This model consist of three representational layers of units, face input units as initial visual representation, name units serving to represent names and semantic units, which represent semantic information about persons. These semantic units could be accessed by names or faces through two different hidden layers of units, which allow the system to learn the association between representational layers. Each layer is bi-directionally connected with the adjacent layer and with other units of the layer. Prosopagnosia is simulated by damaging the visual input units. Therefore, in this model the locus of the deficit impaired face recognition is found in early face perception, which contrasts with the Burton et al. (1991) model where this locus is placed after the extracting of a structural representation of the face.

This view is consistent with the difficulty in matching two unfamiliar faces shown by patients with prosopagnosia, specially when the faces are presented sequentially for short times. Patients with prosopagnosia cannot recognize a face presented 90 sec before (Bauer and Trobe, 1984). De Renzi et al. (1968) found that a patient with prosopagnosia could not correctly match an unfamiliar face with another presented a few seconds before. With computerized testing of patient LH, in which two unfamiliar faces presented for 1.5 sec each with a 1.5 sec ISI, only 58% of the trials were correctly matched as compared to about 94