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# Compensatory strategies in processing facial emotions: Evidence from prosopagnosia

Jean-Yves Baudouin[a,b,*], Glyn W. Humphreys[c]

[a] SPMS, University of Burgundy, Dijon, France
[b] Institut des Sciences Cognitices, UMR CNRS 5015, Lyon, France
[c] Behavioural Brain Sciences, School of Psychology, University of Birmingham, Birmingham B15 2TT, UK

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**Abstract**

We report data on the processing of facial emotion in a prosopagnosic patient (H.J.A.). H.J.A. was relatively accurate at discriminating happy from angry upright faces, but he performed at chance when the faces were inverted. Furthermore, with upright faces there was no configural interference effect on emotion judgements, when face parts expressing different emotions were aligned to express a new emergent emotion. We propose that H.J.A.'s emotion judgements relied on local rather than on configural information, and this local information was disrupted by inversion. A compensatory strategy, based on processing local face parts, can be sufficient to process at least some facial emotions.


*Keywords:* Prosopagnosia; Facial emotion; Compensatory strategy

Prosopagnosia is a disability in recognising familiar people from their faces (Bodamer, 1947). The recognition of people from other cues – such as their voice or their gait – is generally preserved, and the ability to recognise other visual categories of objects can sometimes be spared (for reviews, see Benton, 1990; De Renzi, 1997; Young, 1992). Many studies also indicate that prosopagnosic patients can sometimes process other kinds of facial information, such as emotional facial expressions and gender, whilst the matching of unfamiliar faces can be performed accurately (for a review, see Nachson, 1995; Young & Bruce, 1991). Reversed patterns of impairment, for example where the processing of facial emotion but not identity is impaired, has also been reported (e.g., Humphreys, Donnelly, & Riddoch, 1993; Kurucz & Feldmar, 1979; Parry, Young, Saul, & Moss, 1991). Such data provide support for face recognition models where different mechanisms are held to process contrasting types of facial information (identity, expression, gender, etc.; see, for example, Bruce & Young, 1986; Young, 1992; Young & Bruce, 1991).

It is also established that facial information can be processed in a number of different ways. For instance, there is considerable evidence that face recognition mainly relies on the processing of configural or holistic information rather than on componential analysis of the parts of faces; this configural representation takes into account not only the identity of features but also factors such as the distances separating features (for a review, see Rakover, 2002). Configural processing can also be observed when processing facial emotions (see Calder & Jansen, 2005; Calder, Young, Keane, & Dean, 2000). However, whilst configural processing may be dominant and more efficient for face processing, componential (parts-based) analyses can also play a part. For example, Cabeza and Kato (2000) compared the prototype effect in recognition memory for configural and featural prototypes (the tendency to make false positive responses to novel faces that are prototypical within the range of stimuli presented). They reported a tendency for participants to commit false alarms for both featural and configural prototypes.

Following brain lesion there can be deficits in processing configural information in faces (e.g., Boutsen & Humphreys, 2002; De Gelder & Rouw, 2000; Levine & Calvanio, 1989; Saumier, Arguin, & Lassonde, 2001). These deficits are demonstrated either by the absence of an usual configural effect in prosopagnosic patients (e.g., Boutsen & Humphreys, 2002; Saumier et al., 2001), or by a paradoxical configuration effect (where face processing is better when the saliency of configural information

* Corresponding author at: Université de Bourgogne, Pôle AAFE, Esplanade Erasme, BP 26513, 21 065 Dijon Cedex, France. Tel.: +33 3 80 39 39 64.
*E-mail address:* Jean-Yves.Baudouin@u-bourgogne.fr (J.-Y. Baudouin).

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is reduced, e.g., with upside-down faces, De Gelder & Rouw, 2000). Though such patients may be able to conduct parts-based analyses of faces, such analyses are either inefficient for the task at hand or patients may be overwhelmed by impaired configural information, which interferes with responses to local parts (e.g., Boutsen & Humphreys, 2002; De Gelder & Rouw, 2000, see also De Gelder & Rouw, 2001).

To date, most studies of configural processing in prosopagnosia have concentrated either on recognition tasks or on tasks requiring responses to the structural identity of faces (e.g., identity matching). Consequently, we know little about the role that configural or local part processing might play in the analysis of non-identity information by patients with face processing impairments. Indeed, it is possible that some of the dissociations reported between processing facial identity and other facial properties might reflect the differential contribution of componential analyses to contrasting face processing tasks – for example, if componential analyses can support tasks such as gender or emotion discrimination even when they fail to support face recognition. Indeed, Parry et al. (1991) state that “it is possible that some of the dissociations reported in the existing literature might actually reflect the effect of different task demands, rather than the existence of dissociable face processing pathways” (p. 549). This point is particularly pertinent when we consider emotion recognition, which can involve the assignment of faces into a limited number of emotion categories (see Ekman, 1992; Ekman & Friesen, 1975). Here it is possible that local information about the shape of the mouth or eyebrows may be sufficient to assign a face to an emotion category. There is prior evidence that componential analyses can be used to support identity judgements in a limited set of circumstances (e.g., Newcombe, 1979; Young & Ellis, 1989). For example, Newcombe (1979) observed that prosopagnosic patients had normal performance in identity matching when hairstyle was visible, but not when it was cancelled. Such effects may be even more pronounced when facial emotions have to be categorized.

In the present study, we report the case of a severely prosopagnosic patient, H.J.A., who is impaired at identifying any famous or familiar faces by sight (Humphreys & Riddoch, 1987; Humphreys et al., 1993). H.J.A. also shows poor discrimination of gender and facial emotion (Humphreys et al., 1993). Humphreys and Riddoch (1987) initially reported that H.J.A. tended to use individual features rather than configural representations to recognise faces. This is supported by studies of H.J.A.’s memory for facial information, since he can remember individual features of faces whilst being impaired at making judgements from memory about the configural properties (Young, Humphreys, Riddoch, Hellawell, & De Haan, 1994). More recent investigations have confirmed that H.J.A. does not benefit from configural information in perceptual discrimination tasks, when required to discriminate ‘normal’ from ‘thatcherised’ faces (where local parts have been inverted). Here, for example, he shows an (abnormal) advantage for face parts over whole faces, though face parts appearing in isolation lack important configural cues (Boutsen & Humphreys, 2002).

Tests of H.J.A.’s ability to discriminate facial emotion are of interest because H.J.A. is able to use different forms of information to support task performance. For example, in earlier studies H.J.A. performed normally when he had to recognise facial emotion from a pattern of moving points placed on faces. Also, though impaired with static images, his emotion judgements nevertheless remained above chance. It is possible that this residual ability with static faces is based on local facial features. Such a pattern would be consistent with arguments made from studies of object processing in H.J.A., where the evidence suggests that local features are extracted but not well integrated (see Humphreys, 1999). This was investigated here. It should also be noted that the study took place some ten years after the initial study of H.J.A.’s processing of facial emotion. Studies of H.J.A.’s object processing have revealed that, over a protracted period following his lesion, H.J.A. improved at using visual information for some tasks even though basic visual processing remained at a constant level (Riddoch, Humphreys, Gannon, Blott, & Jones, 1999). It is possible, then, that at the time of the present investigation, H.J.A. may be able to use local features to perform emotion judgements even if his configural processing remains impaired. This may reflect some compensatory recovery along with a stable perceptual impairment.

In the present paper we tested H.J.A.’s ability to process facial emotion when we varied the information available for making the judgements. In Experiment 1, H.J.A.’s ability to process facial emotion was assessed with upright whole faces, where both parts-based and configural information may be present. Subsequently, H.J.A. performed the same task with upside-down faces. Face inversion is known to interfere with the processing of configural and relational information in faces (for reviews, see Hancock, Bruce, & Burton, 2000; Valentine, 1988). If H.J.A. was disrupted in emotion judgements by the presence of configural information (De Gelder & Rouw, 2000), then he may (paradoxically) improve when presented with inverted relative to upright faces (though see Boutsen & Humphreys, 2002, for contrary evidence in a tasks stressing the processing of structural identity). In a second study, H.J.A. performed an emotion recognition task using composite faces (see Young, Hellawell & Hay, 1987). Calder et al. (2000) examined facial emotion judgements to composite faces and reported evidence for a role of configural processing. They found that recognition of the emotion of one facial part (top or bottom) was interfered with by the alignment of another half part that displayed another emotion. This effect was not observed when both parts were misaligned or when the faces were upside-down. Such results suggest that the alignment of parts expressing different emotions creates a new, emergent emotional configuration, that interferes with access to the emotions present in the separate parts. This interfering configural information is made less salient when faces are inverted, so the disruptive effect of alignment is reduced. Recently, Calder and Jansen (2005) have further studied the composite effect on the recognition of facial emotions, suggesting that it arises at an early stage in face processing (i.e., at a structural encoding stage), common to both facial identity and facial expression processing. If H.J.A. is sensitive to configural information when making emotion judgements, then, like normals, he should be impaired when facial parts expressing different emotions are combined, even when the response ought to be made to just one