



Research report

Impaired integration of emotional faces and affective body context in a rare case of developmental visual agnosia[☆]

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ABSTRACT

In the current study we examined the recognition of facial expressions embedded in emotionally expressive bodies in case LG, an individual with a rare form of developmental visual agnosia (DVA) who suffers from severe prosopagnosia. Neuropsychological testing demonstrated that LG's agnosia is characterized by profoundly impaired visual integration. Unlike individuals with typical developmental prosopagnosia who display specific difficulties with face identity (but typically not expression) recognition, LG was also impaired at recognizing isolated facial expressions. By contrast, he successfully recognized the expressions portrayed by faceless emotional bodies handling affective paraphernalia. When presented with contextualized faces in emotional bodies his ability to detect the emotion expressed by a face did not improve even if it was embedded in an emotionally-congruent body context. Furthermore, in contrast to controls, LG displayed an abnormal pattern of contextual influence from emotionally-incongruent bodies. The results are interpreted in the context of a general integration deficit in DVA, suggesting that impaired integration may extend from the level of the face to the level of the full person.

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1. Introduction

Developmental visual agnosia (DVA) is characterized by lifelong difficulties with visual recognition in the absence of evident brain lesions (Gilaie-Dotan et al., 2009). Individuals with DVA may present with impaired object recognition in addition to deficits in face identity and expression processing (Ariel and Sadeh, 1996). This differentiates DVA from pure developmental prosopagnosia (DP) in which the visual deficit

is largely circumscribed to face identity recognition (Dobel et al., 2007; Duchaine et al., 2009a, 2009b, 2003a; Duchaine and Nakayama, 2006b; Garrido et al., 2009; Humphreys et al., 2007). An additional important distinction is that DP is more common, with an approximate prevalence of 2% in the general population (Kennerknecht et al., 2006). By contrast, DVA with deficits in visual integration and object recognition is far rarer and only seldom described in the literature (Ariel and Sadeh, 1996; Duchaine et al., 2003b).

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In the current study we investigated the visual recognition of emotional expressions in LG, a young man with DVA. We tested LG's ability to recognize emotions expressed by isolated faces as well as by faceless emotional body context with affective paraphernalia. Most importantly we were interested in exploring how LG would integrate information from facial expressions with the emotional body context in which the face appears. Successful integration of facial expressions with contextual information may be crucial for interpreting emotions in everyday social interactions in which multiple, and potentially conflicting, channels of emotional information need to be computed (Meeren et al., 2005).

With a few notable exceptions (de Gelder et al., 2006) most previous research on facial expression recognition in healthy individuals has relied primarily on isolated and bodiless faces. The methodological choice of using isolated faces has been guided by the notion that basic facial expressions are universal (Ekman, 1993) and categorically discrete signals of emotion (Etcoff and Magee, 1992; Young et al., 1997). Consequently, these strong signals were assumed to be directly mapped to specific emotional categories while overriding and dominating surrounding contextual information (Buck, 1994; Ekman, 1992; Ekman and O'Sullivan, 1988; Nakamura et al., 1990). More recent accounts acknowledge the potential importance of contextual information (Adolphs, 2006; Brosch et al., 2010), yet current theoretical models do not describe when and how context might influence facial expression recognition (Calder and Young, 2005).

Previous studies addressing the facial expression processing of individuals with developmental as well as acquired visual agnosia and prosopagnosia also focused mostly on the recognition of expressions in isolated faces (Ariel and Sadeh, 1996). Specifically, it is unclear if and how the recognition of facial expressions is influenced by contextual emotional body language in individuals with DVA or DP. Indeed, the few DP studies in which the body as well as face expression were manipulated focused on comparing the facial and body expression processing rather than exploring their possible mutual influence (Duchaine et al., 2006; Van den Stock et al., 2007). While the approach of studying the recognition of isolated facial expressions has proved fruitful, it may have ecological limitations. Real life facial expressions are typically embedded in a rich and informative context which may impede or enhance the recognition of emotions from the face (Zaki and Ochsner, 2009).

Recent work in healthy and neurological populations has indeed shown that emotional body context affects face-based emotion recognition (Aviezer et al., 2008a, 2008b; Meeren et al., 2005; Van den Stock et al., 2007). In fact, under certain conditions, the context can dramatically shift the emotional category recognized from basic facial expressions (Aviezer et al., 2009, 2008a, 2008b). For example, Aviezer and colleagues "planted" prototypical pictures of disgust faces on bodies of models conveying different emotions (such as anger and sadness). Their results showed that placing a face in an incongruent emotional body context induces striking changes in the recognition of emotional categories from the facial expressions. These recent findings indicate that a full understanding of facial expression processing in both healthy and clinical populations may benefit from taking into account the

context in which the face appears. Along this line of research we describe case LG, a rare case of DVA with severe prosopagnosia, focusing on his unique visual integration deficits and follow with an examination of his emotional face–body integration.

2. Case history – LG

LG is a 21-year-old male who was first diagnosed with DVA and prosopagnosia at the age of 8 (Ariel and Sadeh, 1996). He has no psychiatric or neurological disease, an MRI scan found no discernible structural brain abnormality (Gilaie-Dotan et al., 2009) and his low-level vision (acuity, contrast sensitivity, color vision) is basically intact. We next present a brief synopsis of his current condition focusing on his performance in tasks which require visual integration. Additional neuropsychological and neuroimaging information can be found elsewhere (Ariel and Sadeh, 1996; Gilaie-Dotan et al., 2009).

2.1. Global–local processing

LG's performance in the Navon test of hierarchical letters (Navon, 1977) showed the normal pattern of considerable global interference in the local task and much attenuated local interference in the global task. LG's normal global interference resembles that of some DP's (Duchaine et al., 2007a, 2007b); but not of others (Behrmann and Avidan, 2005; Bentin et al., 2007; DeGutis et al., 2007).

2.2. Low-level perceptual integration

LG displayed crowding ($\sim .3$ log units), which is larger than normal as measured with crowded and uncrowded displays of tumbling E patterns (Bonneh et al., 2004). A conspicuous difficulty with dot grouping suggested problems of visual integration that were further investigated. Two tests suggested abnormal early integration mechanisms. In a contour-in-noise card test, (Kovács et al., 1999) his performance was at the level of 5–6 year olds (threshold spacing ratio of ~ 1); in a lateral masking experiment (Polat and Sagi, 1993) he showed no collinear facilitation, which also indicates impairment in local integration mechanisms. In contrast, he performed normally on the standard stereo-vision test (Randot, Stereo Optical Co., Inc).

2.3. High-level perceptual integration

In realistic natural viewing conditions, LG has serious recognition difficulties. Informally, the way he describes his problems is that

"Looking at objects further than about 4 m, I can see the parts but I cannot see them integrated as coherent objects, which I could recognize; however, closer objects I can identify if they are not obstructed; sometimes I can see coherent integrated objects without being able to figure out what these objects are."

Hence, LG is impaired in everyday perception, which inevitably requires the integration of overlapping and non-

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