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Differential impact of disfiguring facial features on overt and covert attention

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ABSTRACT

Observers can form negative impressions about faces that contain disfiguring features (e.g., scars). Previous research suggests that this might be due to the ability of disfiguring features to capture attention — as evidenced by contrasting observers' responses to faces with or without disfiguring features. This, however, confounds the effects of salience and perceptual interpretation, i.e. whether the feature is seen as integral to the face, or separate from it. Furthermore, it remains unclear to what extent disfiguring features influence *covert* as well as *overt* attention. We addressed these issues by studying attentional effects by photographs of unfamiliar faces containing a unilateral disfigurement (a skin discoloration) or a visually similar control feature that was partly occluding the face. Disfiguring and occluding features were first matched for salience (Experiment 1). Experiments 2 and 3 assessed the effect of these features on covert attention in two cueing tasks involving discrimination of a (validly or invalidly cued) target in the presence of, respectively, a peripheral or central distractor face. In both conditions, disfigured and occluded faces did not differ significantly in their impact on response-time costs following invalid cues. In Experiment 4 we compared overt attention to these faces by analysing patterns of eye fixations during an attractiveness rating task. Critically, faces with disfiguring features attracted more fixations on the eyes and incurred a higher number of recurrent fixations compared to faces with salience-matched occluding features. Together, these results suggest a differential impact of disfiguring facial features on overt and covert attention, which is mediated both by the visual salience of such features and by their perceptual interpretation.

1. Introduction

The human face is a critical stimulus during social interactions. It offers observers a variety of cues to identity, gender, emotion and intention, but also to health or biological fitness. Indeed, visual cues from facial appearance can affect our perception of, and behaviour towards others (Zebrowitz & Montepare, 2008). Conversely, a face can signal reduced fitness or even disease through the presence of facially disfiguring features, whose perception can affect observers' cognitions about, and behaviour towards, that person. In this study we investigate the effect of facially disfiguring features on attention to faces. In the following, we will first review the role of facially disfiguring features on behaviour and then discuss their relation to attentional capture by facial stimuli.

Facially disfiguring features (FDFs) such as birth marks, spots, surgical or accidental scars, or certain craniofacial or dermatological disorders (e.g., cleft lip and palate, port wine stains, or vitiligo) can alter facial appearance and influence how the person with the disfigurement is perceived by others. Indeed, FDFs determine not only how the person bearing the feature perceives themselves (Rumsey, 2002) but also how they are perceived and treated by others (Rumsey, Bull, & Gahagan, 1982; Shanmugarajah, Gaind, Clarke, & Butler, 2012; Turner, Rumsey, & Sandy, 1998). For example, Blascovich, Mendes, Hunter, Lickel, and Kowai-Bell (2001) found that participants who interacted with a confederate during a word finding task generated fewer words when the confederate carried a birth mark than when s/he did not. Interestingly, participants who interacted with the birth mark bearing confederate also displayed cardiovascular reactivity consistent with a learned response towards or emotionally negative or threatening stimuli (Öhman & Mineka, 2001). The relationship between a FDFs and threat is further supported by evidence that observers perceive, and respond to, FDFs as disease-signalling. For instance, viewing images of real facial disfigurements can elicit feelings of disgust that correlate with the degree of the disfigurement (Shanmugarajah et al., 2012). Such responses are not limited to explicit measures, but extend to implicit measures as well. For instance, Ryan, Oaten, Stevenson, and Case (2012) asked

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participants to handle objects in the same manner as shown by an actor in a video. When the actor simulated disease symptoms (e.g., influenza) or displayed a (simulated) facially disfiguring feature, participants avoided close facial – oral – contact with the objects and were more likely to display facial disgust. Similarly, Ackerman et al. (2009) found that observers who had been primed to think about disease were slower to disengage attention in a subsequent dot-probe task when being presented with disfigured faces relative to normal ones, or in comparison to participants who had been primed in a neutral control condition. Together, these results suggest that FDFs can elicit, explicitly and implicitly, responses from observers similar to those evoked by threat- or disease-signalling stimuli. They also indicate that these effects might be mediated by a particular attentional control that FDFs exert in the presence of a meaningful semantic context. Whether FDFs can capture attention on their own, i.e. in the absence of such a context, is less clear.

Given the speed and ease with which observers form first impressions from faces (Willis & Todorow, 2006) it is conceivable that the presence of a disfiguring feature alters the way in which observers attend to a face. Eye tracking studies suggest that observers scan faces containing a disfiguring feature differently compared to faces without such features. Ishii, Carey, Byrne, Zee, and Ishii (2009) measured fixation patterns of participants looking at photographs of patients with and without peripheral facial deformities. Observers' gaze direction when viewing faces with deformities was consistently deflected away from the central eye-nose-mouth region of the face and towards the periphery which contained the disfiguring feature. A similar eye gaze bias towards facial disfigurements was reported by Meyer-Marcotty, Gerdes, Reuther, Stellzig-Eisenhauer, and Alpers (2010) who asked observers to view photographs of unfamiliar faces of patients with cleft lip and palate. Such oculomotor biases can also be accompanied by biases in memory and cognition in relation to the faces, such as memory for what the person bearing the FDF said (Madera & Hebl, 2012).

While the above studies suggest that FDFs affect attention, two questions remain unaddressed:

1. *Do facial disfigurements capture covert attention*? First, it is unclear whether FDFs affect overt and covert attention differently. In the aforementioned studies by Ishii et al., Meyer-Marcotty et al. and Madera and Hebel observers were free to make eye movements towards the face stimuli, i.e. to redirect their overt visual attention. The fact that such overt attentional shifts may be driven by preceding shifts of covert attention, i.e. attentional shifts with the eyes still being stationary (see e.g., Carrasco, 2011, for a review), prompts the question whether similar to the observed deflection of gaze towards FDFs there is also a deflection of covert attention. Alternatively, such gaze deflections – typically operationalized on the basis of the durations of fixations on a specified target region cumulated across the inspection period - may reflect an increased level of sustained overt attention towards FDFs only.

2. *Are effects of facial disfigurements on attention due to visual salience alone*? Facial disfigurements by their very nature are visually conspicuous features, i.e., they may attract attention through their visual salience. However, such disfigurements may also capture attention by the fact that they are *facial* features. This raises the question whether the attentional effects of FDFs are modulated by their perceptual interpretation, i.e. whether they are seen as an intrinsic part of the face (e.g.," a spot on a face") rather than as an extrinsic feature, i.e. a feature accidentally coinciding with the face but physically separate from it (e.g., "a spot on the depiction of a face"). Previous studies considering the effect of FDFs on attention (Ishii et al., 2009; Meyer-Marcotty et al., 2010; Madera and Hebel, 2012) contrasted observers' responses to static photographs of faces with or without disfiguring features, thus confounding the relative effects of salience and perceptual interpretation. Similarly, studies assessing the semantics of FDFs, i.e. their ability to signal disease or the threat of infection (Ackerman et al., 2009; Blascovich, Mendes, Hunter, Lickel, & Kowai-Bell, 2001; Ryan et al., 2012), were based on the implicit assumption that FDFs are seen as part of the face, without accounting for the impact this particular perceptual interpretation may have on any subsequent semantic evaluation.

To overcome the above limitations regarding the attentional control FDFs exert and the perceptual interpretation they induce, the present study employed three types of face stimuli: without any added features (henceforth labelled "normal"), with a "disfiguring" feature, and with a "control" feature. As described in more detail in the following section disfiguring and control features were similar in colour and texture but differed in terms of their perceptual interpretation: While disfiguring features were morphed into the face and its outline, control features where placed as rectangular patches over the face such they that did not follow the face outline but rather occluded it. Furthermore, in a calibration study (Experiment 1) a set of faces was derived for which disfiguring and control features were matched in saliency. Using these face stimuli we evaluated effects on covert (Experiments 2 and 3) and overt attention (Experiment 4).

Experiments 2 and 3 employed a variation on the spatial cueing paradigm (Posner, 1980; Posner, Snyder, & Davidson, 1980), in which a predictive central cue directing attention to the left or right visual field was followed by a target stimulus and a distractor face. Participants had to indicate the orientation of the target. Continuous eye tracking enabled to ascertain that observers attended covertly to the cued location.

In Experiment 2, the distractor face (if present) was located opposite to the target. If salient facial features influence covert attention then their presence might increase the interference by distractor faces, especially when attention is directed to the distractor (on invalidly cued trials). In Experiment 3, the distractor face was presented centrally while the target appeared to its left or right side. This allowed to assess the impact of spatial proximity of the target relative and to the location of a salient facial feature on the (dis)engagement of covert attention. In Experiment 4 we measured overt attention to the same faces as in Experiments 2 and 3. Observers viewed peripheral faces to which they made eye movements in anticipation of an attractiveness rating. If salient features capture attention we would expect these to influence the distribution of fixations on the face, with more fixations towards the feature and fewer fixations on the eyes — the preferred fixation region during the spontaneous exploration of normal faces (Barton, Radcliffe, Cherkasova, Edelman, & Intriligator, 2006; Boutet, Lemieux, Goulet, & Collin, 2017).

2. Experiment 1 (stimulus calibration)

Our study involved images of unfamiliar faces which could contain a unilateral salient feature (Fig. 1): a simulated realistic looking skin discoloration on the face, or a feature that partly occluded the face. Our aim was to assess whether attention to faces was affected by the perceptual interpretation of the added feature. More specifically, we used features to the faces (Fig. 1B and C) that possessed similar local visual properties (in terms of contrast, luminance, and texture) but differed regarding their global visual properties such as shape and occlusion, hence inducing a different perceptual interpretation. This construction principle resulted in two types of features: a disfiguring feature (Fig. 1B) that created the impression of a so-called 'port wine stain', morphed to follow the contour of the cheek and jawline and therefore being perceived as an integral part of the face surface; and an occluding feature (Fig. 1C) that could be interpreted as an addition to the image rather than to the face (i.e., a rectangle that partially occludes an otherwise normal face).

These two types of facial manipulations were applied to all faces in our face database. Given that the relative conspicuity of a particular manipulation depends on the spatial context of the individual face, Experiment 1 was conducted to identify a subset of faces for which disfigured and occluded features were matched in terms of their visual salience. For this purpose we adopted a standard procedure used in the object recognition literature to equate featural object manipulations (see, e.g., Davidoff & Roberson, 2002; Biederman & Barr, 1999). It