

*Article*

## **Emotional responses to disfigured faces and disgust sensitivity: An eye-tracking study**

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Running head: Attention to facial disfigurement and DS

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**Abstract**

Facial disfigurement attracts attention and evokes negative emotion, but evidence is lacking for a link between these two reactions. The present experiment (n=29) investigated emotional and attentional reactions to photographs of people with disfigured faces. An eye-tracker was used to measure fixation on internal expressive features and on the forehead. Disfigurement to the internal expressive features invoked a stronger emotional reaction than disfigurement to the forehead. Attention in the area of disfigurement was associated with negative emotion (embarrassment, sympathy, disgust, repulsion) as well as surprise. Attention to the disfigurement, and negative emotion, were related to the trait of Disgust Sensitivity.

*(100 words)*

**Keywords**

Appearance, Cognitive Processing, Disability, Diversity, Emotions, Stigma

## **Introduction**

Disfigurement has been defined as a persistent and significant alteration to an individual's appearance (Krishna, 2009). According to the Changing Faces organisation one person in 111 in the UK has a disfigurement to the face (Changing Faces, Face Equality, 2014) and people with facial disfigurement experience stigmatisation due to their difference in appearance (e.g., Lawrence, Rosenberg, & Fauerbach, 2007; Stone & Wright, 2012). Individuals with facial disfigurement frequently report being stared at in public places (e.g., Jowett & Ryan, 1985) and other studies have reported heightened levels of negative emotional response to a disfigured face (Shanmugarajah, Gaiind, Clarke, & Butler, 2012; Stone & Potton, 2014). Despite this, there is little research linking the attention paid to facial disfigurement and the emotional response to a disfigured face. The present study aimed to gather initial data using eye-tracking methodology to explore how attention relates to the emotional response to a disfigured face, and the relationship with individual differences in the trait of Disgust Sensitivity.

Several studies have reported that a facial disfigurement can have an effect on attention, for example, Halioua, Williams, Murray, et al. (2011) reported in an eye-tracking study that people with facial disfigurement were

stared at more than people without facial disfigurement. Ackerman, Becker, Mortensen, et al. (2009) used a dot-probe paradigm and reported increased attention to faces that were disfigured by the addition of a port wine stain or altering the location of a pupil to indicate strabismus. Stevenage and Furness (2008) reported poorer recall of the contents of a conversation in which a speaker had a skin blemish on the cheek, suggesting the allocation of attention to the skin blemish, and a similar result was reported by Madera and Hebl (2012).

More specifically, eye-tracking studies have generated evidence to suggest that a disfigured region of a face attracts attention more than the corresponding region of a non-disfigured face. For example, Godoy, Ishii, Byrne, et al. (2011a) investigated attention to crooked noses by comparing the same noses pre- and post-operatively with normal noses, finding that the mean fixation durations within the nasal area were higher for the pre-operative faces than the post-operative faces or the normal faces. In another study, Meyer-Marcotty, Gerdes, Stellzig-Eisenhauer, and Alpers (2010) reported that participants looked longer at the nose and mouth area of faces with cleft lip and palate compared to non-disfigured faces. Ishii, Carey, Byre, et al. (2009) observed that an area of peripheral deformity received more attentional focus, and the internally expressive features of eyes, nose and mouth received less

attention, in a face with a peripheral deformity compared to a non-disfigured face.

Stone and Potton (2014) asked participants to report the degree to which they experienced 21 different emotions when they observed disfigured faces, under conditions of high anonymity (which was theorised to promote honest reporting). Participants experienced stronger negative emotions (anger, fear, disgust, anxiety, embarrassment, and repulsion), stronger sorrow emotions (sadness and sympathy), stronger curiosity and surprise, and weaker positive emotions, when they viewed disfigured faces compared to unattractive or attractive faces. Shanmugarajah et al (2012) also reported that observers experienced higher levels of disgust when viewing more strongly disfigured faces.

From the above review it is clear that disfigurement to the cheek, nose, or mouth, attracts attention compared to the same region of a non-disfigured face. Fewer studies have reported that a disfigurement to the eyes or to the periphery also attracts attention. It is also apparent that disfigured faces invoke more negative emotion than non-disfigured faces.

One key area of investigation that appears to have been relatively neglected to date concerns the relationship between attention to a disfigured feature and the emotional reaction of the observer. It might seem obvious that

heightened attention to a disfigured feature compared to a non-disfigured feature would be related to more negative emotional experience, but there is an alternative. It is possible that a perceiver whose emotional experience is particularly negative would seek to reduce their visual attention to a disfigured feature relative to another observer whose emotional experience was less negative. For example, Pond, DeWall, Lambert, et al. (2012) reported that disgust as an emotion motivates behavioural avoidance of a stimulus rather than approach. Similarly, Krusemark and Li (2011) reported suppressed attention to, and perceptual processing of, stimuli that invoked disgust. This is not incompatible with previous observations that across a whole sample of participants both attention and negative emotions are stronger to disfigured faces than non-disfigured faces, if the whole sample includes participants with mildly negative emotional experience in whom attentional focus on a disfigured face is stronger. The present study investigated the relationship between heightened attention paid to disfigured features and the intensity of experience of a range of emotions.

The default location for attention in a typical face is the internal expressive features of eyes, mouth and nose (e.g., Kelly, Mielliet, & Caldara, 2010; Oosterhof & Todorov, 2008; Walker-Smith, Gale, & Findlay, 2013). Comparing central and peripheral regions within the face, Gardiner, Topps,

Richardson, et al. (2010) found that participants reacted more to disfigurements in the centre of the face than to disfigurement on the periphery. For the present study it was hypothesised that a disfigurement to an internal expressive feature (IEF) would result in stronger emotional experience than a disfigurement to the forehead.

Disgust has been linked to the perception of disfigured faces, for example, Curtis, de Barra and Aunger (2011) reported that the emotion of disgust was elicited by the perception of an individual with a deformity, and Stone and Potton (2014) and Shanmugarajah et al (2012) reported that disfigured faces elicit disgust. It has been proposed that facial disfigurement is interpreted as a possible sign of disease and that the emotion of disgust functions to promote avoidance of an individual who may be contagious (e.g., Ackermann et al, 2009; Schaller & Neuberg, 2012). Evolved biases in person perception have a tendency to overgeneralisation and the variety of symptoms of infectious disease suggests it would be wise to avoid anyone whose facial appearance difference from the norm (e.g., Kurzban & O'Leary, 2001). The association of facial disfigurement with the emotion of disgust would suggest that the degree of attention to a disfigured face would vary according to individual levels of Disgust Sensitivity. This trait describes how strongly an individual tends to experience unpleasant emotions when they encounter a

normatively disgust-inducing stimulus. The present study investigated the relationship between Disgust Sensitivity and attention to a disfigured area of a face, and between Disgust Sensitivity and invoked emotion.

The location of the disfigurement was manipulated either by distorting the IEFs of the mouth or the eyes or by adding a peripheral skin blemish on the forehead. Participants were asked to view the faces while their eye-movements were recorded. The hypotheses are as follows:

H1: Negative emotion will be invoked more strongly by a disfigurement to an IEF than by a peripheral skin blemish.

H2: Heightened attention to a disfigured feature compared to the equivalent feature in a non-disfigured face will be related to intensity of emotional experience.

H3: Disgust Sensitivity will be related to attention and to emotion.

## **Method**

### *Participants*

Participants were undergraduate and postgraduate students at the University of East London who participated voluntarily in response to poster advertisements. They represented a range of ethnicities and cultural backgrounds. Two participants were excluded because of calibration errors and



one for failing to comply with instructions (manual responses consistently at maximum). The remaining 29 participants comprised 22 females, 6 males, and one who withheld their gender, with ages ranging from 18 to 42 years, mean age 25.4 years (s.d. 6.1). The sample size of 29 gave 80% power to find a correlation of  $r=0.5$  (explaining one quarter of the shared variance) with alpha at 0.05 (two-tailed).

The ethnic and cultural diversity of the participant sample, and the range of ages, suggests that the results would be generalizable to the general population. Goode, Ellis, Coutinho, and Partridge (2008), in a structured sample of 1,000 adults, reported equivalent levels of prejudice towards people with facial disfigurement across age, gender, educational level, and socioeconomic status, so the relatively high level of education and the predominance of female participants is not likely to have affected the results.

### *Design*

A mixed within- and between-participants design was employed. The within-participants factors were type of face (control vs. structural disfigurement vs. skin blemish) and area of interest (IEF vs. forehead). Thus, a comparison between the effect of structural disfigurement to IEFs and the effect of a peripheral skin blemish could be performed within-participants.

Each participant viewed facial photographs of one man and one woman, each face shown in three versions: control version, structural disfigurement, and skin blemish. In one set the man had a structural disfigurement to the mouth-cheek and the woman had a structural disfigurement to the eye and in the other set the converse arrangement was applied. Approximately equal numbers of participants viewed each set of faces.

### *Materials and Measures*

The faces used in previous experiments (Stone & Wright, 2012; Stone & Potton, 2014) were used again in the present experiment. These comprised two male and two female faces, one of each gender with disfigurement to the eyes and the other with disfigurement to the mouth-cheek. The patient identities were protected by morphing the patient faces with unknown faces, selected to provide a good match on skin tone and age, using the GIMP software to merge the two faces. In order to verify the realism of the merged faces a sample of students at the University of East London (n=10) were asked to select the original faces from a mixed set of the patient faces and the merged faces. Performance was at chance, confirming the realism of the merged faces. The version of each face with a skin blemish was created by superimposing a prominent mole (also obtained from a facial image on the internet) onto the control version of the face, in the same position on the forehead of each face.

Please refer to Figure 1 for examples of stimuli. The selection of photographs of individuals with strikingly different appearance that could not be concealed with make-up was deliberate. Previous research has tended to use minor skin blemishes, e.g., birthmarks and scars, as these can be easily simulated, but participants may wonder why the individual has chosen to display a potentially concealable disfigurement. This could give rise to participant assumptions and reactions that might complicate the purpose of the experiment.

Two Areas of Interest (Aoi) were defined on each face to take in the area of skin blemish and the area of structural disfigurement, so that the whole area of disfigurement was defined on the image and there was no overlap between Aoi. The forehead blemish Aois were approximately the same size on all faces (ranging from 10mm x 10mm to 12mm x 12mm). The faces with disfigurement to the eyes had smaller structural Aoi (ranging from 14x15mm to 18x14mm) than the faces with disfigurement to the mouth-cheek region (ranging from 19x23mm to 22x26mm). It is important to note that type of face was varied within participants, so that the comparison of attentional fixations in a particular Aoi between the disfigured and non-disfigured versions of the face used the same definition of the Aoi.

The Disgust Propensity and Sensitivity Scale (DPSS) of van Overveld, de Jong and Peters (2009) contains 6 questions measuring Disgust Sensitivity,

e.g., “When I feel disgusted, I worry that I might pass out” and “Disgusting things make my stomach turn”. The Disgust Sensitivity scale was of primary interest in the present study as it measures emotional reactions to normatively disgust-inducing stimuli. An additional 6 questions measure Disgust Propensity which was less relevant to the present study. (Disgust Propensity measures individual differences in the likelihood of experiencing disgust, but in the present study the faces were strongly disfigured so it was expected that participants would experience disgust to a substantial degree, hence there would be little scope for individual differences in the experience of disgust). Participants responded to indicate how often each statement was true for them, with options ranging from never to always. The Disgust sensitivity subscale exhibited adequate reliability in the present study (Cronbach’s alpha = 0.72).

Participants were asked to report their experience of 10 different emotions: Anxiety, Confidence, Curiosity, Disgust, Embarrassment, Happiness, Repulsion, Sadness, Surprise, and Sympathy.

The eyetracking system was an Applied Science Laboratories (ASL, Waltham, MA) model 504 remote eye tracking system with a 60Hz sampling rate. Following calibration, the gaze position error was less than one degree. The stimuli were displayed on a 19-inch monitor with a resolution of 1280 x 768 and a refresh rate of 85 Hz. A chinrest with head support was used to minimise

participants' head movements. The size of the visual image on the screen was 6 x 8 cm. The key eye-tracker variable selected for analysis was the percentage of total fixation time that fell within the Aoi (FixDurPct) as this is the variable reported most frequently in previous studies.

### *Procedure*

Participants responded to posters advertising the research on a voluntary basis and were not paid for their participation. On arrival they were briefed and informed of their right to withdraw at any time. All participants reported normal visual acuity and were naïve to the hypotheses of the experiment.

First, the eye-tracker was calibrated. Then participants viewed the six faces in the item set in a random sequence to familiarise them with the stimuli. Each trial consisted of the following sequence: a fixation cross in the centre of the screen for one second, then an emotion word was presented for 2 seconds, then the face for 5 seconds while the participant reported the extent to which they experienced the emotion on a numeric scale of 1 to 4 (corresponding to: not at all, a little, some, a lot), and finally an inter-trial interval. Each trial lasted approximately 10 seconds. Each face was presented 10 times, once for each emotion, making a total of 60 trials.

After the presentation of the faces participants completed the DPSS and then they were debriefed and invited to ask questions. The entire procedure took typically 50 minutes.

It could be argued that there was a possible priming effect of presenting the word before the face. However, all words were presented before all face versions in a randomised sequence so that any effect of positive or negative priming from the specific words was fully counterbalanced. It was necessary to present the word and then the face on its own in order to isolate visual attention to the face.

It could be argued that visual attention to the area of disfigurement was artificially increased by asking the participant to report on their emotional experience. However, the aim of this research was to investigate the relationship between attention to disfigured features and invoked emotions, and the relationship of both to the trait of Disgust Sensitivity, and these relationships were not likely to have been influenced by the particular task demand.

*Ethics:* Ethical approval was granted by the Ethics Review Committee of the University of East London. Every participant gave informed consent to participate in the study.

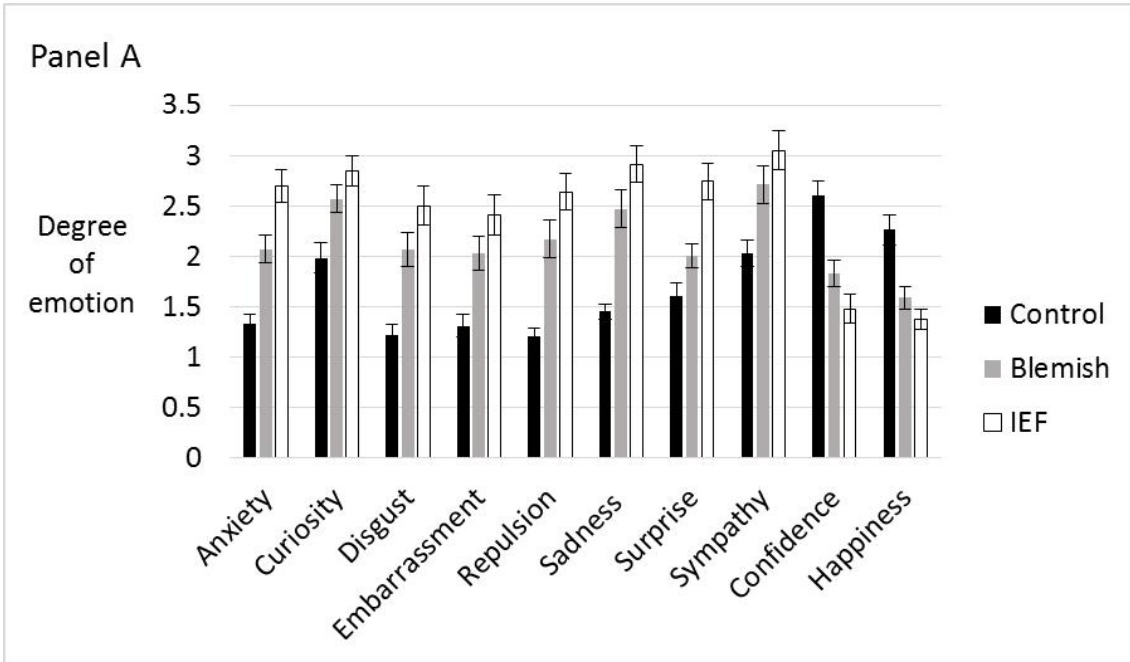
## Results

There were no effects of stimulus gender or participant gender in any of the analyses, so these variables are not reported.

The score on each of the ten emotions was averaged over the two faces of each type (IEF, skin blemish, control version).

The eye-tracker dependent variable FixDurPct was calculated as the percentage of the total viewing time that was focused in the area of interest, for each of the 6 conditions formed by the combination of face type (structural disfigurement, skin blemish, control version) x area of interest (IEF or forehead). Heightened attention to a disfigured feature was calculated as FixDurPct in the relevant Aoi for a disfigured face minus FixDurPct in the same Aoi for a non-disfigured face.

The self-reported experience of the ten emotions invoked by the different face types is presented in Figure 1.



Panel B



**Figure 1.** Panel A: The degree of self-reported emotion invoked by control faces, faces with a forehead blemish, and faces with disfigurement to the internal expressive features. Panel B: Examples of stimuli.



The emotion scores approximated to a normal distribution and so parametric tests were performed. Ten separate Anova were performed, one for each emotion, with face type as the independent variable and measure of emotion as the dependent variable. There was a significant effect of face type on each emotion, all  $F(2,27) > 8.13$ , all  $p \leq 0.005$ . Simple contrasts (using Bonferroni adjustment) revealed that the faces with structural disfigurement invoked more emotion than the faces with skin blemish, which invoked more emotion than the control faces, for these emotions: anxiety, embarrassment, disgust, repulsion, sadness, sympathy, surprise and curiosity (for curiosity, disgust, and sympathy, the difference between faces with structural disfigurement and skin blemish did not reach statistical significance). The pattern was reversed for confidence and happiness (for happiness, the difference between faces with structural disfigurement and skin blemish did not reach statistical significance). This supports hypothesis 1.

Several positive correlations were observed between the heightened attention to a disfigured feature and the emotional experience when viewing the corresponding face; please refer to Table 1. This picture was more consistent for the IEFs, where the emotions of anxiety, disgust, embarrassment, repulsion, sadness, surprise and sympathy were correlated with heightened attention, than for the forehead, where only the emotions of curiosity, embarrassment,

sadness, and sympathy were correlated with heightened attention. The correlations were numerically stronger for the IEFs than for the forehead, though the difference in the correlation coefficients did not reach statistical significance for any emotion.

It appears that heightened attention to a disfigured feature compared to the equivalent feature in a non-disfigured face is associated with a stronger experience of negative emotion.

Significant positive correlations were observed between Disgust Sensitivity and emotional experience, please refer to Table 1. This involved a broader range of emotions for the IEFs, where significant correlations were observed for disgust, embarrassment, repulsion, surprise, and sympathy, than for the forehead, where there were correlations only for curiosity and sympathy. There was also a positive correlation between Disgust Sensitivity and heightened attention to a disfigured feature compared to the equivalent feature in a non-disfigured face, but only for IEFs and not for the forehead. This offers partial support for hypothesis 3.

There were no significant correlations between Disgust Propensity and any of the other variables.

**Table 1.** Correlation of heightened attention, emotional experience, and Disgust Sensitivity. Heightened attention is defined as time spent in the Area of Interest in the disfigured face minus the equivalent time in the non-disfigured face.

	Correlation of heightened attention with emotional experience		Correlation of Disgust Sensitivity with attention and emotional exp.	
	Internal expressive features	Forehead blemish	Internal expressive features	Forehead blemish
Heightened attention	-	-	0.42 *	0.15
Anxiety	0.27	0.02	0.39 *	0.24
Confidence	-0.13	0.04	0.17	0.17
Curiosity	0.36 +	0.43 *	0.44 *	0.41 *
Disgust	0.53 **	0.12	0.44 *	0.35 *
Embarrassment	0.66 **	0.34 +	0.47 *	0.27
Happiness	-0.12	-0.11	-0.01	0.18
Repulsion	0.48 **	0.16	0.49 **	0.41 **
Sadness	0.31 +	0.27	0.21	0.48 **
Surprise	0.45 *	0.16	0.44 *	0.02
Sympathy	0.40 *	0.50 **	0.47 **	0.22

+ =  $p < 0.1$       \* =  $p < 0.05$       \*\* =  $p < 0.01$

## **Discussion**

The results demonstrated that negative emotion was invoked more strongly by a disfigurement to an internal expressive feature than by a peripheral skin blemish (hypothesis 1). Heightened attention to a disfigured feature compared to the equivalent feature in a non-disfigured face co-occurred with stronger negative emotional experience (hypothesis 2). Individual differences in Disgust Sensitivity were related to the degree of heightened attention to a disfigured internal expressive feature, and also to the intensity of emotional experience, especially when the disfigurement affected the internal expressive features (hypothesis 3)

The face with the structural disfigurement to the eye or to the nose and mouth invoked negative emotions (anxiety, embarrassment, disgust, repulsion, sadness, and sympathy) more strongly than the face with a skin blemish on the forehead (though the difference failed to reach statistical significance for disgust and sympathy). This is consistent with evidence that the internal expressive features are more important to face perception than the periphery and that attention is paid to the internal expressive features by default (e.g., Kelly et al, 2010; Walker-Smith et al, 2013). It is not entirely consistent with the results of Godoy, Ishii, Byrne, et al. (2011b) who reported that large peripheral lesions, over 8mm in diameter, were as disturbing as lesions to the internal expressive

features. The forehead skin blemishes used in the present study were over 8mm in diameter and yet they invoked weaker emotion than disfigurement to the IEFs. Perhaps the particular nature of the disfigurements to the IEFs in the present study was more disturbing than the lesions used in Godoy et al (2011b). Future studies could present disfigurements of different types and compare their effects on emotion and on attention.

Hypothesis 2 predicted that attention to a disfigured feature would be related to intensity of emotional experience, although the direction of the association was not specified a-priori. The results showed that the relationship was positive in direction so that stronger emotional experience was associated with more fixation time in the area of the disfigured feature compared to the same feature in a non-disfigured face. It is interesting to note that the relationship between attention and emotion occurred over a wider range of emotions when a disfigurement affected the internal expressive features (disgust, embarrassment, repulsion, sympathy, and surprise) than when the disfigurement affected the forehead (curiosity and sympathy). This pattern may be related to the higher levels of negative emotion invoked by the internal expressive features than by the forehead skin blemish.

The pattern of results rules out an explanation that those participants with particularly strong negative emotional reaction might have averted their

attention from a disfigured feature. The results are not consistent with Pond et al (2012) or Krusemark and Li (2011) who observed attentional avoidance of disgust-invoking stimuli, but they are consistent with other research showing attention to normatively-disgusting stimuli (e.g., Charash & McKay, 2002). A different pattern of results may have been observed in a situation in which the entire face could have been avoided, but that lay beyond the scope of the present study.

The positive association between attention and emotional experience adds to the literature on emotional responses to disfigured faces, and attentional effects of facial disfigurement, by showing that the two are linked. The pattern of results is also consistent with previous research which has not been specific to facial disfigurement, for example, research showing that items invoking emotion receive more attention than neutral items (e.g., Lang & Davis, 2006) and are prioritised for processing in competition with other items (e.g., Anderson, 2005; Most, Chun, Widders, et al., 2005).

Hypothesis 3 predicted that the effects on attention of a facial disfigurement would be related to individual differences in Disgust Sensitivity. The observation that heightened attention to a disfigured internal expressive feature was correlated with Disgust Sensitivity partially supports this prediction, but a similar result was not observed for heightened attention to a peripheral

skin blemish. One potential explanation is that the higher levels of disgust and other negative emotions invoked by a disfigurement to the internal expressive features compared to a peripheral skin blemish meant that reactions to the former were more sensitive to individual differences in Disgust Sensitivity. This would be consistent with the definition of Disgust Sensitivity as the extent to which aversive emotions are invoked by a normatively disgust-inducing stimulus.

Hypothesis 3 also predicted that Disgust Sensitivity would be correlated with the emotions invoked by the disfigured faces. This was supported, with a wider range of emotions for the internal expressive features (anxiety, curiosity, disgust, embarrassment, repulsion, surprise, and sympathy) compared to the faces with a peripheral skin blemish (curiosity, disgust, repulsion, and sadness). It is clear that the influence of Disgust Sensitivity on emotional experience is not specific to disgust but also encompasses other emotions. This is consistent with the findings of Stone & Pottton (2014) in which Disgust Sensitivity was correlated with a range of negative emotions (disgust, repulsion, anxiety, embarrassment, anger, and fear).

It could be argued that questioning the participants about their emotional reaction to the faces might have biased their attentional allocation towards the disfigured features. However, it is not likely that the allocation of attention would

have been affected to a substantial degree given the previous evidence of attentional capture by facial disfigurement; the disfigured features were highly likely to attract attention regardless of the question asked of participants.

The limitations of the study should be noted. A limited range of facial disfigurements were used, and it would be interesting to explore different types of disfigurement, e.g. skin blemish vs. burn scars vs. structural disfigurement. The perceived severity of disfigurement was not controlled between the internal expressive features and the forehead skin blemish so this would be worthwhile in future studies and would help to compare the specific effects of location and severity of disfigurement.

Future studies could also perhaps compare familiar types of disfigurement with less familiar. We are all accustomed to seeing a port-wine stain birthmark, or cleft lip and palate, or scarring. It is possible that the effect of a more familiar type of disfigurement might be less severe than a less familiar type of disfigurement.

In conclusion, this study has shown that there are relationships among the emotions experienced when viewing a face with disfigured features, the attention paid to the area of disfigurement, and individual differences in Disgust Sensitivity.



## Conflict of Interest:

The authors declare that there is no conflict of interest.

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## Appendix

**Table 2:** Means and SDs of the emotions invoked by the three face types.

	Control		Forehead blemish		Structural disfigurement	
	Mean	SD	Mean	SD	Mean	SD
Anxiety	1.33	0.49	2.07	0.75	2.70	0.86
Confidence	2.60	0.72	1.83	0.69	1.48	0.74
Curiosity	1.98	0.82	2.57	0.78	2.85	0.82
Disgust	1.22	0.51	2.07	0.93	2.50	1.00
Embarrassment	1.31	0.57	2.03	0.93	2.41	1.08
Happiness	2.26	0.81	1.59	0.57	1.38	0.53
Repulsion	1.21	0.43	2.17	1.02	2.64	0.95
Sadness	1.45	0.41	2.47	1.01	2.91	0.98
Surprise	1.60	0.76	1.97	0.63	2.74	0.94
Sympathy	2.03	0.71	2.71	1.01	3.05	1.05