



BRIEF REPORT

Embarrassment's effect on facial processing

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Embarrassment's effect on interpersonal perception, specifically facial processing, was explored. Previous work on social anxiety, which some suggest is similar to embarrassment, finds that socially-anxious individuals tend to avoid negative feedback, such as angry eyes. The current work examined whether embarrassment leads to a similar bias or alternatively whether embarrassed individuals are motivated to look for social feedback in order to reconcile with their audience. Eye movements were recorded while participants looked at four different emotional expressions. Embarrassed participants' fixated proportionally more on the eyes than controls and also fixated proportionally less on other less emotionally informative areas of the face compared to controls. Embarrassment appears to have different effects on facial information processing than social anxiety. The authors suggest this is due to asymmetries in motivational states elicited in social anxiety and embarrassment.

Keywords: Embarrassment; Eye movement; Facial perception; Social anxiety.

Though embarrassment may seem like a rather inconsequential emotion, research suggests that it can have strong effects on social behaviour. For example, people sometimes go to extremes to avoid it, e.g., by not practicing safe sex (Leary, 1995), avoiding medical exams (Harris, 2006), or failing to help someone in need (Sabini, Siepmann, & Stein, 2001). The negative feelings associated with embarrassment are due, at least partially, to a desire to avoid negative social evaluation (Miller, 1992). Individuals fail to behave in ways that are beneficial to themselves or to others because they fear embarrassment and negative judgements of others.

Paradoxically, the intense fear of negative evaluation caused by embarrassment may often be unwarranted. Semin and Manstead (1982) found that rather than encouraging negative evaluation, showing embarrassment promoted an audience's positive regard toward an individual. Though this discrepancy between the audience's true feelings and the actor's fears is a potentially rich and useful subject, to date it is largely unexplored. One primary goal of this research was to begin to fill this gap by examining the inter-perceptual processes of embarrassed individuals.

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Embarrassment, social anxiety, and facial processing

Although work on embarrassment and facial processing is lacking, there is research on social anxiety that may be informative. On the surface at least, social anxiety and embarrassment appear to be similar phenomena. Some researchers have argued that both states share a common cause—fear of negative evaluation (Leary, 1995). Both also produce a tendency to think others are judging one more harshly than they actually are (Mellings & Alden, 2000; Miller, 1988). Behavioural similarities exist as well; embarrassed individuals look downward and shift their gaze frequently (Keltner, 1995), while socially anxious individuals avoid making eye contact (Leary, 1995). Such observations led Leary (1995, p. 82) to suggest that embarrassment may be a “special manifestation of social anxiety”.

Thus, one hypothesis is that embarrassment will involve the same type of social perception processing as social anxiety. Like embarrassment, social anxiety leads to an inconsistency between the audience's actual feelings and what the socially-anxious individual perceives the audience to be feeling (Mellings & Alden, 2000). Research suggests that this discrepancy may be partly due to selective attention and visual perception biases, specifically biases regarding negative stimuli, in socially-anxious individuals. To examine this, researchers have tracked participants' eye movements while viewing photographs of emotional faces (Horley, Williams, Gonsalvez, & Gordon, 2003, 2004). Controls followed a typical triangular scanpath, which centred on the eyes, nose, and mouth. Socially-anxious participants, however, avoided making fixations to the eyes of faces displaying negative emotions. The authors suggested that socially-anxious individuals engaged in selective attention in order to minimise social information (such as negative evaluation), which the eyes are particularly effective in conveying (Baron-Cohen, Wheelwright, & Jolliffe, 1997). Other work finds that social anxiety is often associated with an initial orienting toward negative social stimuli followed by avoidance, a pattern

referred to as vigilance–avoidance (Garner, Mogg, & Bradley, 2006; Mogg & Bradley, 2002).

Selective attention biases in embarrassment have not been explored. The similarities between social anxiety and embarrassment suggest one hypothesis: embarrassed individuals will have similar perceptual biases to socially-anxious individuals. However, a functional perspective of embarrassment offers a different hypothesis. Harris (2006) outlined three functions of embarrassment: appeasing the offended, deterring repeated transgressions, and motivating the embarrassed person to repair the damage caused by the social blunder. None of these functions predict that an embarrassed individual would withdraw from social feedback. Instead, the motivation to repair suggests that the individual would be attentive to social feedback. To effectively mitigate a social mistake, one must ascertain the audience's emotional states. For example, laughter over one's own social blunder might be beneficial with a laughing audience, but detrimental with an angry audience. Thus, embarrassment's overarching goal to repair may produce a motivation to gather emotional information from one's audience, in contrast to the socially-anxious person's motivation to withdraw from emotional social information.

Current research

The current work is evidently the first to examine facial processing during embarrassment. To do so, a paradigm used in past research on social anxiety and perceptual processing was employed (Horley et al., 2004). Participants' eye movements were recorded as they looked at photographs of faces displaying different emotional expressions (happy, sad, angry, neutral). To test the hypotheses presented above, we examined the proportion of facial fixations to the eyes, mouth, and the remainder of the face, the durations of those fixations, and the time to first fixation in control and embarrassed participants. A primary focus was embarrassment's effect on processing negative affect, especially as displayed by the eyes, due to

their importance in conveying emotional information (Baron-Cohen et al., 1997).

METHOD

Participants

Fifty-four undergraduates from the University of California, San Diego, participated in exchange for psychology course credit (32 female, $M = 21$, $SE = 0.34$). The sample's ethnicities were Asian (23), Caucasian/White (16), Hispanic/Latino (7), Pacific Islander (3), and other (5).

Materials

Eye movements were collected every 20 ms through corneal reflections of near infrared light produced by a Tobii 1750 Eye Tracker, which automatically excluded data with loss of tracking integrity. Each participant was individually calibrated on five fixation points before data collection. A fixation was defined as a gaze remaining within 1 degree of visual angle for more than 100 ms (Garner, Mogg, & Bradley, 2006).

The stimuli were 8 images (Ekman & Friesen, 1976). Each image contained a picture of a face depicting either a neutral, happy, sad, or angry expression. Images subtended $9.7^\circ \times 15.5^\circ$ of visual angle.

Social anxiety was measured with the Brief Fear of Negative Evaluation scale (BFNE; Leary, 1983a) and Interaction Anxiety Scale (IAS; Leary, 1983b).

Procedure

Participants were tested individually. To disguise the purpose of the study, participants were told that there would be three short experiments, and that the first was a series of questionnaires about life experiences, the second explored the link between vocalisation and facial muscle activity, while the final experiment was for a colleague (about which the experimenter purportedly knew very little). Participants were randomly assigned to either an embarrassment ($n = 25$; 7 males) or control condition ($n = 29$; 11 males).

Under the guise of the first study, all participants completed a demographic sheet and social-anxiety measures. Participants in the embarrassment condition then were handed lyrics for "*Everything I Do, I Do it for You*" written by Bryan Adams, Mutt Lange, and Michael Kamen. Participants were told that they would be video recorded singing this song. A webcam was placed on a computer monitor directly in front of the participants. If the participants voiced any concerns about singing, the experimenter was instructed to respond, "Just try the best you can". Control participants were handed five paragraphs of information about the North American Blue Jay and were told that they would be video recorded reading the paragraphs.

The experimenter left the room while the participants sang/read. Upon returning, the experimenter watched the video recorded performance. Participants sat behind the experimenter and were able to fully view their recorded performance, while only seeing the back of the experimenter's head. Experimenters were trained to maintain a neutral expression and demeanour.

Immediately after watching the recording, participants sat in front of an eye-tracker. Participants were instructed that the final experiment was beginning, which involved viewing images that they could look at in any way they chose. The first image presented was a blank screen for 15 seconds, followed by the image of a face for 10 seconds. This cycle was repeated for all 8 images. The first four faces were of a female with a neutral, happy, sad, and angry expression respectively. The next four faces were of a male. Expression order was counterbalanced: angry, sad, happy, neutral.

RESULTS

Manipulation check

After the experiment, participants rated the degree to which they felt six emotions (embarrassment, nervousness, anxiousness, sadness, regret, and happiness) on a 7-point Likert scale. One participant did not complete this form. *T*-tests comparing

condition (embarrassment vs. control) were produced for each emotion term. The embarrassment condition ($M=3.08$, $SE=0.33$) elicited significantly more self-reported embarrassment, $t(51)=3.763$, $p<.001$, than the control condition ($M=1.64$, $SE=0.21$). Regret and nervousness were also significantly greater in the embarrassment condition than in the control condition, $t(51)=2.101$, $p<.05$; $t(51)=2.571$, $p<.05$, respectively. Additional paired t -tests were then performed to compare the levels of embarrassment, regret, and nervousness within each condition. These analyses revealed that within the embarrassment condition self-reported embarrassment was significantly greater than regret, $t(24)=3.116$, $p<.01$, and almost significantly greater than nervousness, $t(24)=1.864$, $p=.075$, suggesting that embarrassment was the primary emotion experienced during the task. Within the control condition, no significant differences in ratings of these different emotions emerged. Self-reported embarrassment was correlated with regret and nervousness in the embarrassment condition, $r(25)=.424$, $p<.05$; $r(25)=.564$, $p<.01$, respectively, but only with nervousness, $r(28)=.586$, $p<.01$, in the control condition.

Social anxiety

To determine whether the embarrassment and control conditions differed on self-reported social-anxiety levels, t -tests were conducted. There were no significant differences between conditions (BFNE, $p=.891$; IAS, $p=.144$).

Correlational analyses showed that social-anxiety measures were correlated with each other, $r(54)=.643$, $p<.001$. Social-anxiety scores were unrelated to self-reported embarrassment, BFNE $r(25)=.263$, $p=.205$; IAS $r(25)=.052$, $p=.806$, in the embarrassment condition but were correlated in the control condition, BFNE $r(28)=.505$, $p<.01$, IAS, $r(28)=.340$, $p=.076$, suggesting

the embarrassment manipulation reduced the relationship between social anxiety and self-reported embarrassment.¹ To ensure that social anxiety was not influencing the effects of the embarrassment manipulation, social-anxiety scores were included as a covariate in our eye-tracking analyses. They proved to be a non-significant covariate and therefore were excluded in the analyses reported below. Furthermore, correlational analyses of social anxiety scores and eye-tracking measures did not reveal significant relationships. The only exceptions were both social-anxiety measures negatively correlated with time to first fixation to the sad face, IAS $r(52)=-.333$, $p<.05$; BFNE $r(52)=-.295$, $p<.05$, and IAS negatively correlated with proportion of fixations to the angry mouth, $r(54)=-.289$, $p<.05$. The general lack of relationship with social-anxiety levels is not surprising given that this sample was drawn from a non-clinical population and none of the control subjects received a social threat, which may be necessary for non-clinical levels of social anxiety to impact these eye movements (Garner et al., 2006).

Overall number of fixations

To examine possible differences in the overall number of fixations made by embarrassed and control participants, an ANOVA was conducted comparing condition on number of fixations to the photographs. Embarrassed ($M=20.26$, $SE=1.49$) and control ($M=20.23$, $SE=1.38$) participants did not significantly differ in the number of overall fixations to the photographs, $F(1, 52)=0.000$, $p=.989$.

The remaining analyses employed a repeated-measures mixed ANOVA design (between-subject variable was Condition: embarrassment vs. control; within-subjects variable was Type of Facial Expression being presented: neutral, happy, sad, and angry). For all analyses, we averaged

¹ Given the findings for regret and nervousness noted previously, we performed additional correlations on these measures. Regret was significantly correlated with IAS in the embarrassment condition and with BFNE in both conditions, $r(25)=.417$, $p<.05$; $r(25)=.535$, $p<.01$; $r(28)=.401$, $p<.05$, respectively. IAS significantly correlated with nervousness in the sample as a whole, $r(54)=.296$, but did not reach significance when examined separately for the two conditions, $p>.175$.

across the two photos that displayed the same emotional expression.

The next analyses focused on fixations made to the face of the photograph (subtending $7.6^\circ \times 10.0^\circ$ of visual angle and extending from the outside of one cheek to the outside of the other and the top of the head to the bottom of the chin). There was no significant difference between the number of facial fixations made by embarrassed participants ($M = 18.46$, $SE = 1.36$) and controls ($M = 18.79$, $SE = 1.27$), $F(1, 52) = 0.031$, $p = .860$, nor a significant main effect for Type of Expression, $F(3, 156) = 0.232$, $p = .874$. There was not a significant interaction between condition and type of expression, $F(3, 156) = 0.623$, $p = .601$, suggesting that embarrassed participants do not particularly avoid threatening faces.

Proportion of fixations to the eyes, mouth, and other areas of the face

Our next analyses focused on the pattern of fixations made to the face. We were specifically interested in whether embarrassed individuals attend to specific regions of the face differently than controls. Our primary areas of interest were the eyes (subtended $6.2^\circ \times 2.1^\circ$ of visual angle and included the area from the top of the eyebrow to bottom of the eye socket and within the outside corners of the two eyes) and to a lesser extent the mouth (subtended $5.0^\circ \times 1.9^\circ$ and extended just past the outside of the lips).

To determine whether participants were differentially attending to specific regions of the face, proportions of fixations to the eyes, mouth, and rest of the face were calculated by dividing the number of fixations to each specific region by the total number of facial fixations. This proportion was calculated for each expression type and each facial region.

The overall proportion of fixations to the eyes was significant for Condition, $F(1, 52) = 4.621$, $p < .05$. Embarrassed participants fixated proportionally more on the eyes than control participants (see Table 1). We also found a significant effect of Type of Expression, $F(3, 156) = 7.414$, $p < .001$. Across condition, more fixations tend to be made to

the eyes of negative expressions than to those of neutral or happy expressions. As shown in Table 1, in contrast to the literature on social anxiety, embarrassment-condition participants proportionally fixated most on the eyes of angry expressions (particularly when compared to fixations on the eyes of happy or neutral faces). However, the omnibus interaction term did not reach significance, $F(3, 156) = 1.332$, $p = .266$, and control participants also looked at angry eyes more than happy eyes.

The next analyses focused on the mouth region. In contrast to the increased fixations seen in the analyses of the eyes, embarrassed participants fixated on the mouth significantly less than controls, $F(1, 52) = 5.733$, $p < .05$. There was also a significant effect for Type of Expression, $F(3, 156) = 4.554$, $p < .005$, with the mouth of the happy expression being fixated on more than the mouth of other expressions (see Table 1). There was no interaction between Type of Expression and Condition, $F(3, 156) = 0.715$, $p = .545$.

Analyses of fixations to the remainder of the face, excluding the mouth and eyes, did not reveal significant main effects of Condition nor a significant interaction ($ps > .186$), though there was a main effect of Type of Expression, $F(3, 156) = 4.734$, $p < .01$ (see Table 1). This pattern suggests that embarrassment primarily influenced fixations to the eyes and mouth. This issue was further explored with two additional tests. We performed proportional analyses similar to those that were conducted above for the eyes and mouth, except instead of using the total number of facial fixations as the denominator, we used total facial fixations excluding the other area of interest (i.e., the proportion of fixations to the eyes was calculated by taking the number of fixations to the eyes divided by the total facial fixations minus the number of fixations to the mouth). The effect of Condition remained for the eyes, $F(1, 52) = 3.709$, $p = .06$, but did not reach significance for the mouth, $F(1, 52) = 2.550$, $p = .116$. Thus, it appears that embarrassment particularly influenced attention to the eyes.

Table 1. Percent of fixations to areas of interest

Region of the face	Type of expression				Mean
	Neutral	Happy	Sad	Angry	
<i>Eyes</i>					
Embarrassed	36.2 _a ¹²	31.2 _b ¹	39.7 _{ac}	44.1 _c ²	37.8
Control	26.3 _{ac} ¹	23.4 _a	31.2 _b ¹	28.5 _{bc}	27.3
Mean	31.3 _a ¹	27.3 _b	35.4 _c ¹	36.3 _c	
<i>Mouth</i>					
Embarrassed	8.7 _a	15.2 _b ¹	11.2 _{ac} ¹	13.0 _{bc}	12.0
Control	15.9 _a ¹	19.0 _b ¹	15.0 _a ¹	16.9 _{ab}	16.7
Mean	12.3 _a ¹	17.1 _b	13.1 _{ac}	15.0 _{bc} ¹	
<i>Rest of face</i>					
Embarrassed	55.1 _a	53.6 _a	49.1 _{ab}	42.9 _b	50.2
Control	57.8 _a	57.6 _a	53.8 _a	54.6 _a	56.0
Mean	56.5 _a ¹	55.6 _a	51.5 _b ¹	48.8 _b	
<i>Eyes without mouth</i>					
Embarrassed	39.3 _{ab}	36.5 _a	44.2 _{bc}	49.2 _c	42.3
Control	31.1 _{ab}	28.3 _b ¹	36.0 _a	33.9 _a ¹	32.3
Mean	35.2 _a ¹	32.4 _a	40.1 _b ¹	41.5 _b	
<i>Mouth without eyes</i>					
Embarrassed	15.1 _a ¹	21.6 _b ¹	19.5 _{ab}	20.0 _{ab}	19.0
Control	22.4 _a	25.1 _a	22.6 _a	22.5 _a	23.2
Mean	18.8 _a	23.3 _b	21.0 _{ab}	21.3 _{ab}	

Notes: Percent of fixations within the same row that have different subscript letters are significantly different at $p < .05$, with the exception that different letters that are accompanied by the same superscript number are different at $p < .10$.

Temporal aspects

The relationship between fixation duration and condition was assessed with analyses that parallel those performed on number of fixations. No significant main effects or interactions for duration (all $ps > .098$) were revealed. Average gaze duration to the face for embarrassed participants was 271.35 ms ($SE = 42.92$) and for control participants, 250.35 ms ($SE = 39.85$). This rules out the possibility that embarrassed individuals are making a greater number of fixations but for less time.

We also examined how long it took for participants to make their first fixations to the face, the eyes, and the mouth, but found no significant condition effects or interactions (all $ps > .278$). Embarrassed participants took 304.94 ms ($SE = 113.95$) to fixate on the face and controls, 443.05 ms ($SE = 98.68$). There was one significant within-subjects effect of expression

type, $F(3, 51) = 5.963$, $p < .01$: Participants fixated faster on the mouth of the happy expression than any other expression (Happy $M = 1375.49$, $SE = 285.50$; Neutral $M = 2784.24$, $SE = 360.53$; Sad $M = 3194.29$, $SE = 443.16$; Angry $M = 2810.64$, $SE = 397.73$).

DISCUSSION

This study compared perceptual processes in embarrassed and control participants while viewing various emotional expressions. Embarrassed participants had a different pattern of facial processing compared to controls and this appeared to be distinct from the pattern reported in the social-anxiety literature. First, embarrassment created none of the vigilant and avoidant attentional biases previously reported in socially-anxious individuals (Garner et al., 2006). Embarrassed participants

were no faster in fixating on negative social stimuli, nor were their fixations to such stimuli shorter in duration relative to control participants. The current work, however, did reveal that embarrassment produces unique attentional patterns. Embarrassed participants focused a larger proportion of their fixations to the eyes and a smaller proportion to the mouth compared to non-emotional participants. This pattern was particularly strong when embarrassed individuals were viewing angry expressions relative to happy or neutral expressions. Thus, instead of decreasing attention to the most socially informative area of the face, embarrassment seemed to increase it.

The most probable explanation for these findings is that embarrassed participants are focusing a larger proportion of their fixations to the eyes because of the emotional feedback carried specifically in the eyes. Individuals more easily identify complex emotions when viewing the eyes alone rather than the mouth alone (Baron-Cohen et al., 1997). The eyes are also a cue for recognition of emotional intensity (Matsumoto, 2005). Moreover, the eyes are a key indicator of the focus of someone's attention and when individuals attempt to intensify an emotion, regardless of the emotion type, they prolong their gaze (Kimble, Forte, & Yoshikawa, 1981). These studies highlight the effectiveness of the eyes at conveying emotional information, though they do not address why embarrassed individuals would want to gather information about another's emotional state or the intensity of that state.

We believe that embarrassed individuals are attracted to emotional feedback from their audience because of the motivational properties of embarrassment. At its core, embarrassment drives individuals to repair their own social pratfalls. There are a number of recovery strategies that people employ to restore normal social interactions and the strategy chosen may be based on the situation rather than on personality or emotional intensity (Cupach & Metts, 1992). A currently unexplored possibility is that individuals choose their strategy by integrating the situation with the observer's reaction. Thus, choosing the correct

recovery strategy may necessitate gathering information about the audience's emotional state.

Our results seem to be consistent with this viewpoint. The finding that the proportion of fixations to the eyes of negative expressions was greater than to other expressions suggests that embarrassed participants were not shying away from emotional information. Instead, they seemed to be seeking it out. Other work has found that motivational states can affect eye gaze, including selectively attending to certain types of emotional information in order to regulate one's emotional state (Isaacowitz, 2005). In the present case, the motivation to repair may be driving embarrassed participants to increase their fixations to another's eyes.

As noted previously, the eye-processing pattern found here for embarrassment is different from the selective attention patterns of social anxiety. Although embarrassment and social anxiety seem intuitively connected, our findings suggest that the two states may have some important differences in underlying motivations and interpersonal processing. Other work suggests that another potentially significant difference is the temporal aspect of these constructs. Embarrassment has a large reactive component (a response to a social blunder) while social anxiety may be primarily anticipatory (an apprehension about future negative evaluations; Harris, 1990).

While more work is needed to determine the boundaries between these two constructs, the potential differences may offer suggestions for avenues to explore in the treatment of social anxiety disorder. Previous research suggests that biases in processing emotional stimuli may contribute to the persistence of some emotional disorders (Gilboa-Schechtman, Foa, & Amir, 1999; Gotlib, Krasnoperova, Yue, & Joorman, 2004; Salters-Pedneault, Tull, & Roemer, 2004). In the case of social anxiety, vigilance-avoidance mechanisms may lead patients to see negative evaluation due to hypervigilance, but to fail to see the dissipation of negative evaluation because of avoidance. This may create an expectation that others are continuing to view them negatively. It is possible that this creates a deleterious downward

spiral as poor coping behaviour may lead to worse social interactions (Horley et al., 2004; Leary, 1995). A similar phenomenon may occur in depression (and other emotional disorders), as depressed individuals are more attentive of sad faces and also withdraw from social interactions (Gotlib et al., 2004; Segrin, 2000).

In contrast, embarrassment can produce positive social consequences (Harris, 2006; Semin & Manstead, 1982). One possibility is that embarrassed individuals monitor the reactions of the audience more than socially-anxious individuals, which enables them to gain the necessary information to repair the situation. While embarrassment is associated with immediate reactions of glancing down and frequent gaze shifts (Harris, 2001; Keltner, 1995), our work suggests that embarrassed individuals also monitor the emotional reactions of others, particularly as conveyed through the eyes, as they attempt to cope with their embarrassing predicament. Continuous monitoring also may signal to others the desire to remain part of the group, whereas in social anxiety looking away has been suggested to signal that disengagement is desired (Horley et al., 2004). Thus, attempts to train people with clinical levels of social anxiety to attend to emotional information might be useful. Social skills training is used with depressed individuals with some success (Segrin, 2000).

Future work also is needed to determine whether clinically-socially-anxious individuals actually show the prototypical embarrassment reactions found in non-clinical samples. It is possible that their reactions during embarrassment are different from control participants and, therefore, may not have the positive social consequences seen with non-clinical samples. However, conducting such studies experimentally may prove ethically difficult.

One limitation of this study is that we cannot rule out the possibility that our findings were due to the other emotions that were elicited by our manipulation. Participants in the embarrassment condition rated themselves as significantly more regretful and nervous than control participants. However, embarrassment was the primary emotion

elicited, as participants reported significantly more embarrassment than any other emotion in the embarrassment condition. It seems difficult to imagine a scenario in which embarrassment is felt without at least some regret or nervousness. Therefore, we suggest that they are not so much alternative states as they are part of the embarrassment predicament.

The perceptual processes and biases of the embarrassed individual are for the most part unexplored. We suggest a few additional areas for future study. First, the connection between the reaction of the audience and the face-saving strategy chosen by the embarrassed individual needs to be further examined. Second, further work could explore the specific information the embarrassed individual is gaining from increasing attention to the eyes. Likewise, exploring the audience's reactions to the embarrassed individual's increased eye contact would be informative. Finally, further temporal examination of embarrassed individual's eye movements should be undertaken including examining early and late stage attentional processes, which may shed light on these issues.

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