I Blush, Therefore I Will Be Judged Negatively: Influence of False Blush Feedback on Anticipated Others’ Judgments and Facial Coloration in High and Low Blushing-Fearfuls

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Abstract

In the present study, we investigate whether people attribute costs to displaying a blush. Individuals with and without fear of blushing were invited to have a short conversation with two confederates. During the conversation, half of the individuals received the feedback that they were blushing intensely. The study tested whether the belief that one is blushing leads to the anticipation that one will be judged negatively. In addition, the set-up permitted the actual physiological blush response to be investigated. In line with the model that we propose for erythrophobia, participants in the feedback condition expected the confederates to judge them relatively negatively, independent of their fear of blushing. Furthermore, sustaining the idea that believing that one will blush can act as a self-fulfilling prophecy, high-fearfuls showed relatively intense facial coloration in both conditions, whereas low-fearfuls only showed enhanced blush responses following false blush feedback.
Fear of blushing can be an impairing complaint. People with fear of blushing experience their fear in many social situations. Consequently, they avoid those situations in their daily lives (Bögels, 2006). The heavy burden of the complaint is further evidenced by the substantial number of blushing-fearfuls who consider a drastic surgical solution to prevent blushing, although such a medical intervention is not without risks (Dijk & de Jong, 2006). However, it is not entirely clear as yet why blushing-fearful individuals live in fear of their blushing. In an attempt to facilitate the understanding of this fear, we propose a cognitive model of fear of blushing1 (Figure 1).

![Cognitive model of fear of blushing](image)

**Figure 1.** Cognitive model of fear of blushing.

The trigger stimulus in the model is the belief to be blushing, which can be true but also false. That is, several studies showed that blushing-fearfuls are characterized by a fearful preoccupation with blushing that is irrespective of their actual facial correlation (e.g., Mulkens, de Jong, Dobbelaar, & Bögels, 1999). As can be seen in Figure 1, the belief that one is blushing is assumed to give rise to negative and dysfunctional beliefs regarding the costs of blushing (cf. Foa, Franklin, Perry, & Herbert, 1996). For example, people with a fear of blushing might expect to be rejected by others, when they notice their bodily symptoms (Bögels, 2006). The anticipation of costs causes fear, which in turn further fuels the vicious circle. That is, the fear of blushing leads to more self-focused attention, and this self-focused attention causes a quicker detection of small temperature changes in the blushing part of the face, thus leading to an enhanced sensation of blushing (Mulkens et al., 1999). Furthermore, it is conceivable that the combination of fear and the acute awareness of one’s public self may indeed enhance the physiological blush response, since

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1 This model is a simplified version of a model that the first author developed together with Femke Buwalda for a psycho-educational treatment for fear of blushing.
concerns about other’s evaluations are assumed to elicit blushing (Darwin, 1989/1872; Leary, Britt, Cutlip, & Templeton, 1992).

One critical assumption of the model is that the belief that one is blushing visibly leads to the anticipation of costs, such as a negative judgment by others. Thus far, there is only preliminary support for this link in the model. A recent vignette study tested the costs that are attributed to blushing in situations in which people commonly blush, such as being the center of attention (Leary et al., 1992), or the exposure of something personal (Crozier, 2004). The study showed that participants generally expected that blushing in these situations would negatively affect others’ judgments (Dijk & de Jong, 2009). However, testing this type of anticipated judgments using a vignette approach has drawbacks. Although explicit considerations regarding the anticipated interpersonal effects of displaying a blush can be successfully investigated using a vignette methodology (cf. Dijk & de Jong, 2009), the question remains whether individuals are always able to accurately predict how they would react (e.g., Parkinson & Manstead, 1993).

Therefore, the present study was designed to test the costs that are attributed to displaying a blush in a more real-life, yet controlled setting. Individuals with and without fear of blushing were invited to have a short conversation with two confederates who where unknown to them (Öst, Jerremalm, & Johansson, 1981). During the conversation, half of the individuals received the feedback that they were blushing intensely (cf. Drummond, 2001; Wild, Clark, Ehlers, & McManus, 2008). A critical prediction of the proposed model (see Figure 1) is that experimentally imposing the belief that one is blushing will lead to the anticipation that one will be judged negatively by the confederates. Furthermore, unlike the previous vignette study (Dijk & de Jong, 2009), with the present “in vivo” set-up we were able to investigate whether the expected costs of blushing reflected biased or accurate beliefs. For example, in line with what has been found for socially-anxious individuals, it could be that blushing-fearfuls show an enhanced bias in terms of the discrepancy between the actual judgment of the confederate and the judgment they expect (e.g., Rapee & Lim, 1992; Stopa & Clark, 1993; Voncken & Bögels, 2006).

In addition, the present set-up has allowed us to investigate whether the false blush feedback influences the physiological blush-response during the social task. If believing that one is blushing can act as a self-fulfilling prophecy (Drummond, Camacho, Formentin, Heffernan, Williams, & Zekas, 2003), this might explain why several studies have found that blushing-fearfuls do sometimes blush more often and more intensely than people without this fear do (Bögels, Rijsemus, & de Jong, 2002; Gerlach, Wilhelm, Gruber, & Roth 2001; Hofmann, Moscovitch, & Kim, 2006; Voncken & Bögels, 2008). We hypothesize that the blushing-fearfuls in the present study will believe that they
blush regardless of the feedback, while non-fearfuls only believe they blush when they are given the feedback that they blush. By measuring the physiological blush response, the study investigated whether this belief does coincide with a physiological blush reaction.

To summarize, the present study tested the following hypotheses: i) People who receive the feedback that they are blushing during a conversation with two confederates expect that these confederates will judge them less favorably than people who do not receive this feedback. ii) False blush feedback elicits or intensifies the actual physiological blush response, especially in low-fearful individuals. Furthermore, although not explicitly predicted by the model for erythrophobia, the present study also examined if high blushing-fearfuls attribute more costs to blushing than low-fearfuls: (iii) when high-fearfuls receive the feedback that they blush, they anticipate a more negative judgment from the confederates than low-fearfuls, and (iv) there is an enhanced discrepancy in high-fearfuls between the actual and anticipated judgment of the confederates.

**Method**

*Participants & Assessment*

The participants were 100 women, first-year students at the University of Groningen (72 psychology students, 15 medicine students and 13 pedagogy students). The participants earned course credits or, when they did not need these credits, were paid five euros. They were invited to participate, based on their score on a previously completed blushing subscale of the Blushing Trembling and Sweating Questionnaire (BTS-Q) (Bögels & Reith, 1999). Of the individuals who completed the BTS-Q, 462 indicated that we could contact them for further research. From this group, we invited 50 blushing-fearfuls (BTS-Q-score > 50; Heinrichs et al., 2006) and 50 low-fearfuls (BTS-Q-score < 30) to participate. Because this pre-measurement of the BTS-Q occurred during a mass screening several weeks before the experiment was scheduled, we asked all participants to fill out the BTS-Q again on the day of the study. We excluded from all analyses those participants who switched from being high-fearful (BTS-Q > 50) to low-fearful (BTS-Q<30) and vice versa. By doing so, we excluded three previously high-fearful individuals, two in the control condition and one in the feedback condition. None of the low-fearful participants switched to becoming high-fearful.

For a more comprehensive description of the sample, the participants completed the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977), the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998), the brief Fear of Negative Evaluation Scale (BFNE; Leary, 1983; Cieraad & de Jong, 2007), the social phobia subscale of the Fear Questionnaire (FQ; Marks and Mathews, 1979) and the nineteen-item version of the Blushing
Propensity Scale (BPS; Bögels, Alberts & de Jong, 1996) that was originally developed by Leary & Meadows (1991). Means and standard deviations are displayed in Table 1.

Table 1
Means (Standard Deviations) of the Assessment Scales and their Correlations with the Blushing Part of the Blushing Trembling and Sweating Questionnaire (BTS-Q).

<table>
<thead>
<tr>
<th>Scale</th>
<th>M (SD) Low</th>
<th>M (SD) High</th>
<th>rBTS-Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>CES-D (0-60)</td>
<td>10 (9)</td>
<td>13 (10)</td>
<td>.14</td>
</tr>
<tr>
<td>SIAS (0-80)</td>
<td>18 (12)</td>
<td>30 (13)</td>
<td>.52**</td>
</tr>
<tr>
<td>FNE (0-48)</td>
<td>21 (10)</td>
<td>30 (10)</td>
<td>.54**</td>
</tr>
<tr>
<td>FQ (0-40)</td>
<td>12 (7)</td>
<td>19 (6)</td>
<td>.53**</td>
</tr>
<tr>
<td>BPS (0-76)</td>
<td>31 (14)</td>
<td>49 (11)</td>
<td>.71**</td>
</tr>
<tr>
<td>BTS-Q (0-100)</td>
<td>21 (12)</td>
<td>58 (12)</td>
<td>-</td>
</tr>
</tbody>
</table>

** Correlation is significant at the p< 0.01 level.

Note. SIAS = Social Interaction Anxiety Scale, FNE = Fear of Negative Evaluation; FQ = Fear Questionnaire; CES-D = Center for Epidemiologic Studies Depression Scale; BPS = Blushing Propensity Scale. Except for CES-D the difference between high and low-fearfuls was significant at the p < 0.001 level. For CES-D: t (95) = -1.48, p =0.142.

**Social Task**

The participants were instructed to initiate and maintain a five-minute conversation with two unknown confederates, one male and one female. The group of confederates consisted of two men and three women, who were all psychology students of the University of Groningen. The confederates received three hours of training to prepare them for the task. They were instructed to leave the burden of the conversation to the participant during the conversation. That is, they were not allowed to change the subject of the conversation and were only allowed to take the initiative when the participant was silent for seven seconds. Furthermore, they were limited in their responses to three pieces of information per answer (Boone et al., 1999; Öst et al., 1981). The participant was instructed that the purpose of the conversation was to get acquainted with these unknown individuals. Moreover, she was told that she was allowed to talk about everything except the study, which included the recording devices and the feedback apparatus.

**Feedback Manipulation**

The participants were randomly assigned to one of two conditions: a feedback condition (n_{high-fear} = 24; n_{low-fear} = 26) and a control condition (n_{high-fear} = 23; n_{low-fear} = 24). In both conditions a vibrating device was attached to the
participant’s finger and in both conditions the participant received the same vibrations.

In the feedback condition the participants received the following instruction: “During the conversation we would like to give you feedback about the intensity of your blush, because we know from research that people are not always able to accurately feel if they are blushing. There are many people who blush without knowing it, and there are also many people who think they are blushing when they are not. For example, one can feel the cheeks become warm without the presence of visible blush and, likewise, one can feel nothing at all while there is a clear visible blush. [...] The vibrating device works as follows: the more the device vibrates, the more you have blushed and thus were visibly redder.” For the control condition participants the instruction was as follows: “We have two conditions, an experimental condition and a control condition. You are in the control condition. During the conversation, people in the other condition will receive feedback about the intensity of their blushes. However, since you are in the control condition you will receive yoked feedback. In other words, you will receive the feedback from someone else’s blush. This feedback does not concern you; you will just receive these vibrations to control for the effect of the vibrations.”

We used a silent kind of blushing feedback (the vibrations) to ensure that confederates remained blind to the nature of the condition (cf. Wild et al., 2007). Furthermore, the vibrations that the feedback device delivered were not constant, but varied at intervals of 30 seconds to prevent habituation. Participants were informed that every 30 seconds the apparatus calculated the intensity of their blush and that the intensity of the vibrations reflecting their or the other person’s visible blush intensity in the preceding 30 seconds. A new interval was announced by a soft bleep. During the first 30 seconds the vibrations were fairly mild to “set the stage,” but increased during the beginning of the social task and remained quite intense during the whole conversation.

Procedure
The procedure was carried out in a room that was maintained at 22 ± 1.5 °C. On entering the lab, the participants received a short instruction about the procedure. At this point they were only told that they would receive physiological feedback and that the study was about social situations, but no specific details about the conditions or the social task were mentioned. They were asked to fill out an informed consent, and then the experimenter interviewed the participant about blush-relevant substances (such as tranquillizers, antidepressants and coffee). Participants were already informed not to drink coffee before the experiment and none of the participants needed to be excluded because of the use of vasoconstricting/dilating substances.
After these questions the physiological recording devices were attached (see “Physiological Measures”), meanwhile the experimenter explained to the participant what kind of measurements were being taken.

When all the devices were attached, the participant was instructed to sit calmly for a three-minute baseline period during which the experimenter left the room. After these three minutes the experimenter entered the room again and gave the instruction that determined the conditions (see “Conditions”). After the experimenter made sure that the participant understood this instruction, the social task was explained to them (see “Social Task”). The experimenter left the room, the two confederates entered and the social task started. During the social task the vibrating device attached to the participant’s finger delivered variable vibrations in intervals of 30 seconds (see “Conditions”).

After five minutes the vibrating device was shut off and the experimenter walked into the room to end the task. The confederates went to another room in which they filled out several questionnaires about the participant (see “Subjective Measures”). The experimenter released from the recording device the hand that the participant used to write, and asked the participants to fill out several questionnaires and some manipulation checks (see “Subjective Measures”). When they had finished answering these questions, the experimenter entered the room again and released the remaining recording devices. The participants were fully debriefed about the false feedback, the purpose of the study and the condition they were in. They also got the opportunity to ask questions. Finally, the participants were asked to fill out the questionnaires mentioned under “Participants & Assessment”.

**Measures**

**Physiological Measures**

Output from all electrodes was recorded on a Pentium 2 PC (Operating system: DOS 6.22) using data acquisition software with a sample frequency of 100 Hz.

**Physiological Blush Response.** Cheek coloration was used to index participants’ blushing and was recorded from a plethysmograph transducer fastened to the skin with tape for sensitive skin on the zygomatic bone near the inner canthus. To measure changes in the level of individuals’ cheek coloration (i.e., the level of blood pooling) rather than changes in pulse amplitude, the transducer was modified in such a way that it was DC-coupled rather than AC-coupled (cf. Shearn, Bergman, Hill, Abel, & Hinds, 1990; Mulkens et al., 1999).

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2 There were several more questionnaires, irrelevant for the present inquiry, which have not been presented here.
As a result, the transducer was able to record slow signals. Furthermore, the frequency of the infrared light of the plethysmograph transducer was modulated in such a way that surrounding light could not influence the signal.

Facial Skin Temperature. Cheek temperature was monitored unilaterally with a semi-conductive thermistor fastened to the skin, just below the plethysmograph transducer.

Subjective Measures

Participants’ Self Report. This questionnaire contained six visual analogue scales (VAS), ranging from 0 - 100. The first four VASs investigated the judgment that participants anticipated from the confederates. This entailed the anticipated confederates’ judgment of 1) their social skills, 2) their competence, 3) their likeability and 4) their global evaluation. All VASs were scaled in such a way that a higher score reflected a more favorable judgment. The last two VASs concerned the subjective experience of their blushing during the conversation: 5) how often they blushed and 6) how intensely they blushed. Both VASs were scaled in such a way that a higher score indicated more blushing.

Confederates Ratings. Both confederates were asked to fill out the first four VASs of the judgmental questionnaire of the participant. These concerned the judgment of the participants’ performance for the constructs mentioned above.

Manipulation Check. To examine the possibility that high-fearfuls would pay more attention to the probe (Mansell, Clark & Ehlers, 2003), we asked the participants, on a scale from one to five, to what extent they paid attention to the feedback. A higher score indicated that more attention had been paid to the feedback. Furthermore, participants were asked, again on a scale from one till five, if the feedback corresponded to their own blush experience and if they believed the feedback. For both items a higher score indicated that the feedback was more credible.

Data Reduction

Physiological Measures

The physiological parameters were analyzed off-line by means of a specially designed computer program. For the baseline period, participants were asked to sit quietly for three minutes. As soon as the participant was seated and the experimenter had left the room, the value of the plethysmograph was set to zero. This allowed assessing the change in signal value from baseline to task. In accordance with previous research we then calculated difference scores as an index of responsivity (e.g., Gerlach et al., 2001; Shearn et al., 1990).
Participants’ Self Report

We calculated a mean score for the first four VASs of the judgmental questionnaire to obtain a mean anticipated judgment score ($\alpha = 0.90$). To obtain a subjective blush experience, we calculated the mean score of VAS five and six ($\alpha = 0.91$).

Confederate Ratings

First, we examined the inter-rater reliability for the two confederate ratings (ICC = 0.75, 0.77, 0.38 and 0.58 for social skills, competence, likeability and global evaluation, respectively). The moderate agreement for likeability and global evaluation was also seen in previous studies (e.g., Alden & Wallace, 1995), and is probably due to more subjective elements in these constructs. We calculated the mean score for all the confederates’ judgments in order to obtain one judgment of confederate score ($\alpha = 0.91$).

Results

Manipulation Check

For the attention that participants paid to the vibrations, we conducted a 2-condition (feedback vs. control) by 2-group (high-fear vs. low-fear) ANOVA in order to examine if there was a difference between high and low-fearful participants. The results indicated that there was no significant difference between the high-fear group and the low-fear group ($F(1,92) < 1$). Furthermore, there was no significant difference between the two conditions in this respect ($F(1,92) = 2.94, p = 0.09$), and no interaction between group and condition ($F(1,92) = 2.21, p = 0.14$). The two items that measured the credibility of the blush feedback were only analyzed for those participants in the feedback condition. The two t-tests showed that high and low-fearfuls did not differ in the extent to which they believed the feedback ($t_s < 1$; $M_{\text{high-fear correspond}} = 2.96; M_{\text{low-fear correspond}} = 3.08; M_{\text{high-fear believed}} = 3.29; M_{\text{low-fear believed}} = 3.27$).

Subjective Measures

Subjective Blush Experience

To examine the participants’ subjective blush experience, we conducted a 2 group (high-fear vs. low-fear) by 2 condition (feedback vs. control) ANOVA; the means and standard deviations are displayed in Table 2. The analyses revealed a main effect of condition ($F(1, 93) = 25.31, p < 0.001, \eta^2_p = 0.21$). As the manipulation intended, participants in the feedback condition reported a stronger belief that they had blushed than participants in the control condition. There was also a main effect of group ($F(1, 93) = 21.08, p < 0.001, \eta^2_p = 0.19$); in general, high blushing-fearfuls believed more than low-fearfuls that they had blushed intensely and often. The interaction between group and condition was also significant ($F(1, 93) = 3.87, p = 0.05, \eta^2_p = 0.04$). Therefore, subsequent t-tests were performed. These t-tests showed that, as expected,
both groups believed that they blushed more in the feedback condition than in the control condition ($t_{\text{low}}(48) = 4.70, p < 0.001, d = 1.33; t_{\text{high}}(45) = 2.32, p = 0.03, d = 0.67$). Yet, in line with the predictions, in the feedback condition the difference between high and low-fearfuls in perceived blush intensity was not significant ($t_{\text{feedback}}(48) = 1.82, p = 0.08, d = 0.52$), whereas in the control condition high-fearfuls believed they blushed more than did low-fearfuls ($t_{\text{control}}(45) = 4.75, p < 0.001, d = 1.39$).

**Costs of Blushing**

To estimate the costs that are attributed to blushing and to estimate whether high-fearful participants showed a biased perception of the confederates’ judgments, we conducted a 2 group (high-fear vs. low-fear) by 2 condition (feedback vs. control) by 2 rater (participants vs. confederate) repeated measures ANOVA. The means and standard deviations are displayed in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>Low-Fearful</th>
<th>High-Fearful</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Feedback (n=26)</td>
<td>Control (n=24)</td>
</tr>
<tr>
<td>Subjective Blush Experience</td>
<td>56 (22)</td>
<td>29 (19)</td>
</tr>
<tr>
<td>Judgmental Biases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated judgment</td>
<td>56 (15)</td>
<td>61 (13)</td>
</tr>
<tr>
<td>Judgment of confederate</td>
<td>67 (16)</td>
<td>72 (12)</td>
</tr>
</tbody>
</table>

Note. The anticipated judgments are composed of the means scores of social skills, competence, likeability and global evaluation.

For the within-subject effects, the analysis revealed a main effect of rater ($F(1, 93) = 43.68, p < 0.001, \eta^2_p = 0.32$); participants expected a poorer judgment than they actually received from the confederate. This effect was independent of group or condition; none of the interactions were significant (all $F<1$). This indicates that the high-fearfuls did not show any enhanced discrepancy between the judgment they received from the confederate and the judgment they anticipated. For the between-subject effects, the analyses revealed a main effect of condition ($F(1,93) = 7.12, p = 0.01, \eta^2_p = 0.07$). Participants in the feedback condition both anticipated and received a more negative evaluation than participants in the control condition. There was no effect of group ($F(1, 93) = 1.65, p= 0.20, \eta^2_p = 0.02$), thus high-fearfuls did not anticipate or receive a more negative judgment than did low-fearfuls. In addition, there was no interaction between group and condition ($F(1, 93) <1$),
indicating that, compared to low-fearful participants, high-fearful participants did not anticipate or obtain a more negative judgment as a result of the feedback.

**Physiological Measures**

Cheek temperature and blood pooling correlated moderately ($r = 0.37$, $p < 0.001$). The responsivity scores for both physiological blush measurements were analyzed in a 2 (high fear vs. low-fear) by 2 (feedback vs. control) ANOVA. Note that, by analyzing this deviation between baseline and task, the intercept reflects the difference between these two time points. Means and standard deviations of the physiological measures are displayed in Figure 2.

![Figure 2](image)

*Figure 2. Graphical display of the means and standard deviations of the blush and temperature response.*

**Blood Pooling**

The intercept for the blush response was significant ($F (1,93) = 345.73$, $p < 0.001$, $\eta_p^2 = 0.79$), indicating that participants blushed more during the social task than during the baseline. There was no effect of feedback ($F (1,93) < 1$), but there was a non-significant trend for group ($F (1,93) = 2.72$, $p = 0.10$, $\eta_p^2 = 0.03$). Furthermore, the interaction between group and feedback showed a non-significant trend ($F (1,93) = 3.32$, $p = 0.07$, $\eta_p^2 = 0.04$). Subsequent t-tests showed that, in line with the predictions, there was no difference between high and low-fearful participants for the feedback condition ($t (48) < 1$), whereas in the control condition high-fearfuls did show a stronger blush response than low-fearfuls ($t (45) = -2.62$, $p = 0.01$). In addition, in the high-fear group there was no difference between the two conditions ($t (45) < 1$),
whereas in the low-fear group participants blushed more in the feedback condition than in the control condition ($t(48) = 2.22, p = 0.03$).

**Cheek Temperature**

The intercept of the temperature response was significant ($F (1,93) = 440140.50, p < 0.001, \eta^2_p = 1.00$); thus, the cheek temperature of the participants was higher during the social task than during the baseline. There was no effect of group ($F (1,93) = 1.39, p = 0.24, \eta^2_p = 0.02$) and no effect of feedback ($F (1,93) < 1$). In addition, the interaction between group and feedback did not reach significance ($F (1,93) = 2.15, p = 0.15 \eta^2_p = 0.02$).

**The Relationship between the Subjective Blush Experience and the Physiological Blush**

We wanted to examine the relationship between the subjective blush experience and the physiological blush, and also to examine whether the discrepancy between the subjective and physiological blush was related to fear of blushing. To obtain a more reliable physiological blush score, we computed a mean standardized score of both physiological blush measurements (temperature and blood pooling, $z = 0.54$). This physiological blush score correlated moderately with the subjective blush experience ($r = 0.38, p < 0.001$). Next, we subtracted the standardized physiological score from the standardized subjective blush score ($Z_{subjective\ blush} - Z_{physiological\ blush}$). A higher (more positive) score of this newly created variable indicates that a participant overestimated the subjective blush as compared to the physiological blush. The correlation between the BTS-Q and this deviation score was moderate but significant ($r = 0.26, p = 0.01$), indicating that the more the participant feared blushing, the stronger the discrepancy between their subjective and physiological blush responses.

**Discussion**

The main results can be summarized as follows: (i) independent of fear of blushing, participants in the false blush feedback condition expected the confederates to judge them relatively negatively, (ii) high-fearfuls showed enhanced facial coloration in both conditions, but low-fearfuls only showed enhanced blush responses in the false feedback condition; this physiological pattern corresponded to the subjective blush experience, (iii) compared to people without fear of blushing, high blushing-fearful individuals did not show an enhanced expectation of the costs of blushing, (iv) nor an enhanced discrepancy between the anticipated and actual observers’ judgments.

In support of the proposed cognitive model for fear of blushing (Figure 1) and in line with a previous vignette study (Dijk & de Jong, 2009), the participants anticipated a less favorable judgment from the confederates when they were informed that they were blushing. Furthermore, also in line with the
findings of this earlier vignette study (Dijk & de Jong, 2009), the negative outcome expectancy regarding the judgment of others appeared irrespective of fear of blushing. What did differ between high and low-fearfuls, was that high-fearfuls reported enhanced subjective blush ratings irrespective of the feedback, whereas low-fearfuls only believed they blushed when they were informed they were. Thus, consistent with the study that used a vignette methodology (Dijk & de Jong, 2009), the present "in vivo" study showed that fear of blushing appears to be characterized by an anticipation of a negative judgment by others when blushing combined with the enhanced subjective blush intensity.

Interestingly, the feedback not only influenced the subjective blush experience but also affected the physiological blush. More precisely, in line with the subjective blush experience, low-fearfuls who were given blush feedback showed more facial coloration than low-fearfuls who were not given this feedback. High blushing-fearfuls showed equally high blush responses in both conditions. This finding is in correspondence with a pilot study of Leary and colleagues (1992) that showed that well over half of the participants displayed an immediate increase in facial temperature in response to the experimenter's remark that they blushed. Also Drummond and colleagues (2003) found that blush responses increased when participants received false blush feedback after an embarrassing task. However, their study showed that false blush feedback only intensified the blush response of individuals who scored high on a blushing propensity measure (Leary & Meadows, 1991). In the present study the high-fearful participants appeared to blush anyway and especially the low-fearfuls seemed affected by the blush feedback. This difference is probably due to the difference in methods that were used: while our participants received the feedback during the course of the social task, in the study of Drummond participants received feedback after the embarrassing task. Individuals without concerns about their blushing (as indexed by a low score on a blushing propensity measure) might not be influenced by blush feedback when the task has already past. Nevertheless, all studies seem to indicate that the expectation or belief to blush can serve as a self fulfilling prophecy. One possible mechanism for this could be as follows: when one believes that blushes indicate weakness (as blushing-fearfuls do [Dijk, de Jong, Müller & Boersma, in press]), then believing one is blushing enhances self-consciousness and embarrassment, which then elicits the blush (Drummond, 2001). Accordingly, it would appear that the higher subjective blush ratings of people with fear of blushing do not merely reflect a biased judgment irrespective of actual coloration, as was suggested in earlier studies (e.g., Mulkens, de Jong, Bögels, 1997).

This does not, however, imply that fear of blushing is not related to an overestimation of the blush response. In fact, our results showed that the
discrepancy between the subjective blush experience and the physiological blush was related to fear of blushing. The more people feared blushing, the higher their subjective blush estimates were relative to the physiological blush. Thus, there appears to be evidence for both mechanisms: blushing-fearfuls do blush more easily than low-fearfuls, but at the same time they also do overestimate (in comparison to non-fearful participants) the intensity of their blush.

The present study confirms that the belief one is blushing brings about negative beliefs about the judgment of others, and might even enhance the feared blush response itself. This finding may help explain why a considerable group of blushing-fearfuls consider a surgical cutting of the sympathetic nerve in order to disable the blush response altogether (e.g., Nicolaou, Paes & Wakelin, 2006; Drott, Claes & Rex, 2002). Although in the case of a panic disorder, no surgeon would intervene by removing the heart to prevent palpitations, in the case of fear of blushing, destroying a perfectly healthy nerve is quite common. This seems especially alarming as the results hint that several psychological mechanisms can be addressed to decrease blushing complaints in blushing-fearfuls. First, the fear of negative evaluation can be addressed with cognitive therapy. Both high and low blushing-fearfuls expected a more negative evaluation because of their blush. Although blushing-fearfuls did not show a stronger bias concerning this negative evaluation than did people without fear of blushing, it still seems feasible that they fear blushing because of this negative evaluation. In fact, previous studies have shown that blushing-fearfuls do show a higher fear of negative evaluation than people without fear of blushing (e.g., de Jong & Peters, 2005). Results from our study show that there is probable room for improvement in the anticipated negative evaluation of others, since the judgment of our confederates was more positive than that anticipated by the participants.

Second, the results of the present study have shown that those participants who received the blush feedback received a poorer judgment from the confederates than those who did not receive this information. Thus, the belief one is blushing resulted in behavior that somehow caused a poorer judgment, both in the high and in the low-fearful participants. Since people with fear of blushing generally believe that they blush often and intensely (e.g., Dijk & de Jong, 2009; Mulken et al., 1997), they might show similarly awkward behavior in real social situations. Accordingly, blushing-fearfuls may be helped with training that aims to continue normal behavior while blushing, for example, in the form of adjusted social skills training (Bögels & Vonecken, 2008). Such an adjusted social skills therapy consists of several exercises. One part of the therapy is a task concentration training that helps to focus attention on the social task and away from the blush area (e.g., Bögels, 2006; Mulken, Bögels, de Jong & Louwers, 2001). This would be particularly useful since the
available evidence clearly indicates that fear of blushing is related to an overestimation of the intensity of the blush reaction. Furthermore, it has been suggested that the fear of showing bodily symptoms might be associated with a lack of self disclosure about this fear (Bögels & Voncken, 2008). Therefore, in an adjusted social skills therapy individuals are trained to talk with others about their symptoms, give acceptable explanation for the symptoms, and express feelings of insecurity.

The present study has several limitations. First, the participants were high fearful students rather than treatment seeking patients and it would be helpful to replicate these results in a clinical population to confirm that the present findings also apply to people who seek help for their complaints. Nevertheless, the mean BTS-Q-score for the high-fear group in the present study is similar to that reported for treatment-seeking groups (e.g., Mulkens and colleagues, 2001). Second, although the confederates were trained to be blank and neutral, they acted as confederates multiple times and were aware that blushing was being evaluated. Thus, they might have been socialized to view the relationship between social skills and blushing in a certain way. In future research, blushing is ideally measured more secretly (e.g., via an infrared camera), and confederates participate only in one conversation. Third, although the methods of vascular measurement (a thermistor and a photoplethysmograph) are objective blush measures, they are derivatives of the visible blush. The visibility of the blush depends on multiple factors (such as the capacitance in facial cutaneous vasculature and the amount of α- and β-adrenoceptors that are present in the facial vein). Hence, it can not be ruled out that the actual visibility of the blush may have been different from the physiological blush response. Furthermore, these methods are sensitive to measurement noise, which might have caused some statistical weaknesses such as the non-significant trends for the blood pooling measure.

In conclusion, the present study was the first to show “in vivo” that notification that one is blushing leads to the anticipation of a poorer judgment from others. This was in line with the proposed cognitive model for fear of blushing that predicts that the belief one is blushing or the blush sensation will lead to negative beliefs regarding the costs of blushing. This negative anticipation appeared not to be characteristic for high blushing-fearful individuals: both high and low blushing-fearful individuals were found to

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3 Although placing the probe on the zygomatic bone caused little movement errors, some large errors in the signal did occur. These parts of the physiological data were deleted from the selected time period and the mean values were calculated on the remaining signal. Furthermore, we also ran the physiological blush analyses with room temperature as a covariate. This did not change the significance of any of the results.
expect costs from their blushing. What does characterize blushing-fearfuls is an enhanced belief that one actually is blushing (which might act as a self-fulfilling prophecy). In other words, blushing-fearfuls are characterized by an enhanced trigger stimulus (the blush sensation) in the proposed model for fear of blushing.