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HIGH BLUSHING PROPENSITY: FEARFUL PREOCCUPATION OR FACIAL COLORATION?

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Summary—Twenty-seven women with high scores on the Blushing Propensity Scale (BPS) and 26 women with low BPS scores were exposed to two different video segments. One video showed the subject's own singing, recorded in a previous session and the other video showed a segment of Hitchcock's movie *Psycho*. During the experiment, facial coloration, facial temperature, and skin conductance level were measured. In addition, subjects' blushing intensity was judged by raters. Finally, subjects were asked to rate their blushing intensity and fear of blushing during the video presentations. Subjects generally blushed more during the presentation of their singing than during comparison stimulation, as measured physiologically. There were no between group differences in this respect. No differences were found between the two groups on raters' judgements about blushing intensity. However, high BPS subjects dramatically overestimated their blushing intensity and were more afraid of blushing than low BPS subjects. During the mere presence of the raters, high BPS subjects tended to show a relatively strong coloration. Thus, the BPS seems to reflect both a fearful preoccupation and a stronger facial coloration. © 1997 Elsevier Science Ltd

INTRODUCTION

Blushing is a quite common physiological reaction that is seen across cultures and among persons of different age and sex (Darwin, 1872; Edelmann, Asendorpf, Contarello, Zammuner, Georgas, & Villanueva, 1989). People blush in a wide variety of situations. Yet, the stimuli that can elicit a blush seem to be restricted to the following four categories: threats to public identity, praise and other forms of positive attention, scrutiny, and accusations of blushing (Leary, Britt, Cutlip, & Templeton, 1992). Virtually all people blush at least occasionally (Edelmann, 1990). There are people, however, who report that they blush more frequently than other people (Leary & Meadows, 1991).

Some people find it extremely aversive to blush and even develop a blushing phobia. It seems reasonable to assume that high blushing propensity might be a vulnerability factor for developing fear of blushing or even blushing phobia. In line with this, it has been demonstrated that fear of blushing is, indeed, associated with blushing propensity, as indexed with the Blushing Propensity Scale [BPS(Bögels, Alberts, & de Jong, 1996)].

Thus far, studies on individual differences in blushing propensity have only relied on self report measures. Therefore, it can not be excluded that these measures primarily reflect a subjective feeling rather than objectively observable phenomena. From a cognitive perspective, it might be argued that people high in blushing propensity falsely believe that they blush more often/intense/visible than other people and, therefore, consider themselves as deviating from social standards (e.g. Clark & Wells, 1995; Edelmann, 1987). If so, blushing may become an aversive stimulus. In other words, it might be that some people only think that they blush more often/intense/visible than other people and become anxious as a consequence. Alternatively, it might be that people who display high scores on the BPS, indeed, objectively blush more often than people with low scores on the BPS and, as a result, might be vulnerable for developing fear of blushing.

To investigate whether people who consider themselves high in blushing propensity (i.e. high scores on the BPS), indeed blush more often/intense than people who consider themselves low in blushing propensity, we had people high and low in blushing propensity undergo an induction, intended to elicit blushing. *S*s visited the laboratory twice. On the first day, they sang a song in front of a camera; on the second day, they watched the recorded tape of their singing in the presence of research confederates, while blushing was recorded (cf. Shearn, Bergman, Hill, Abel, & Hinds,

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1990, 1992). Singing has been used succesfully to induce embarrassment in face-saving experiments (Brown & Garland, 1971; Garland & Brown, 1972; Shearn *et al.*, 1992). Furthermore, watching one's own singing in the presence of other people incorporates at least two of the four situations in which people tend to blush: threat to the public identity and scrutiny.

During the experiment proper (i.e. watching the videos), blushing was measured physiologically as well as subjectively. Physiological parameters were changes in blood flow which were expected to reflect visibility of the blush, and temperature changes, which were expected to reflect interoceptive cues of blushing (i.e. warmth). In addition, the visibility of the blush has been assessed by two raters, who were blind with respect to the classification of *Ss* (high or low in blushing propensity). Finally, *Ss* were asked to rate their blushing intensity during the video presentation. If the BPS is an adequate index of the degree/frequency of blushing, one would expect *Ss* who consider themselves high in blushing propensity to show a stronger physiological blushing reaction, to indicate higher scores on a subjective measure of blushing, to receive a higher score on blushing as judged by raters and have a retarded recovery rate than *Ss* who score low on blushing propensity.

With the above-mentioned procedure, it is also possible to test the alternative hypothesis, namely, that people who are high in blushing propensity according to the BPS do not objectively blush more often/ intense, but tend to overestimate their blushing reaction. Additionally, this procedure provides the opportunity to investigate whether self reported blushing propensity is connected with interoceptive signals (i.e. temperature changes) rather than with the visibility of the blush as determined by blood flow and raters' data. That is, it may well be that *Ss* with high BPS scores are characterized by relatively large temperature changes rather than by large visible bloodflow changes.

Following Shearn's design, we also used a control stimulation that was not intended to produce blushing but to elicit autonomic activity (a segment from Hitchcock's thriller *Psycho*). Skin conductance levels were measured as a physiological correlate. When arousal levels remain the same while watching both video segments, a stronger blushing reaction in response to the singing video would support Leary's view that people blush in circumscribed social situations instead of in general arousal-inducing situations.

METHOD

Subjects

Between 8 months and 3 weeks prior to the experiment, 286 female undergraduate students from Maastricht University completed the Blushing Propensity Scale (BPS; see below). From this sample, 53 *Ss* were selected on the basis of their scores on this questionnaire and their willingness to cooperate in research. In order to create two extreme groups, only *Ss* with a BPS score in the lowest third and the highest third of the distribution were invited to participate in the experiment. At the time of the experiment, we had *Ss* complete the BPS again, to be sure that *Ss* were properly classified as high or low in blushing propensity.

Ss were 26 women low in blushing propensity and 27 women high in blushing propensity. Mean BPS scores of low and high frequent blushers were 11.4 (SD 3.9; range 3–17) and 51.3 (SD 5.3; range 40–63), respectively. At the time of the experiment, mean BPS score of low frequent blushers was 18.3 (SD 8.5; range 2–32) and mean BPS of high frequent blushers was 52 (SD 8.3; range 36–65). Mean age of low BPS *Ss* was 19.7 (SD 3.0; range 18–33) and mean age of high BPS *Ss* was 19.1 (SD 1.2; range 17–22). *Ss* received a small financial compensation for their participation in the experiment.

Assessment

The BPS originally consisted of 14 circumscribed social situations for each of which the *Ss* has to indicate how often she feels herself blushing (Leary & Meadows, 1991). In the Dutch version, five items were added to the original version, in order to cover a wider range of situations in which people tend to blush, including the dimension of being accused of blushing, proposed by Leary and co-workers (1992). The additional items are "When I'm being accused of blushing", "When I think I may start blushing", "When the subject of conversation is sex", "When I'm interacting with

someone who I find attractive", "When I'm criticized". Answers range from "0" ("I never feel myself blushing in that situation") to "4" ("I always feel myself blushing in that situation").

According to the results of a psychometric study of Bögels *et al.* (1996), the internal consistency of the BPS is high (Cronbach's $\alpha = 0.92$). The BPS is a stable instrument, as the test–retest reliability in this study indicates ($r = 0.93$; $n = 53$).

Design

The design consisted of one within-subjects factor: type of stimulation (intended to evoke blushing vs intended to generally arouse) and two between-subjects factors: blushing propensity (high or low), and order of presentation of stimulation (the song first or the movie scene first). The dependent variables were cheek temperature, cheek coloration, finger skin conductance, self reported fear of blushing, self reported blushing intensity, and raters' judgement of blushing intensity.

Apparatus and recordings

Cheek coloration was recorded from a HP model 15230A plethysmograph transducer that was modified in such a way that it was d.c. coupled rather than a.c. coupled. The probe operates in the infrared spectrum. Cheek temperature was assessed by means of a temperature dependent resistor (PT100) that was d.c. coupled.

Skin conductance level was recorded from two Beckman Ag–AgCl electrodes (8 mm dia), placed on the medial phalanges of the middle finger and ring finger of *S*s' non-dominant hand, using the method of constant voltage (0.5V). The electrodes were filled with an isotonic paste and connected to a Beckman Skin Conductance Coupler (type 9844). All physiological signals were sampled with a frequency of 1000 Hz by a Compaq 486 (33 Hz) computer.

Color video recordings of the *S*'s singing were made with a Sony Hi-8 video camera recorder (CCD-TR650E) and a JVC video cassette recorder (HR-D800EG/E). The *S* was seated 2 m from a 51 cm dia Sony color television (KV-M2101D) when stimulation was presented during the second session.

Stimulation

Three different types of videotapes were used in the experiment: a neutral baseline video (i.e. a steady television test card), a video that was intended to elicit blushing (i.e. the individual's singing, recorded during the first session) and a video that was intended to generally arouse (i.e. the shower murder scene from Hitchcock's *Psycho*). Prerecorded videotapes were presented in the following order: 5 min of neutral baseline material, one type of stimulation (song or *Psycho*), 5 min of neutral baseline material, other kind of stimulation (song or *Psycho*), 5 min of neutral baseline material. Order of presentation of both types of stimulation was counterbalanced across *S*s high and low in blushing propensity.

The stimulation, intended to elicit blushing, was the *S*'s own prerecorded singing presented on the television set in the presence of two male confederates, who responded with neutral eye contact. The duration of this stimulation varied because some individuals sang faster than others, but it lasted at least 20 sec and at most 40 sec. The duration of the other type of stimulation was always 50 sec. To assess the rate of recovery, psychophysiological measures were recorded for an additional 40 sec after both types of stimulation. In case of the stimulation intended to produce blushing, the two male confederates had left the room already when the recovery assessment started.

Procedure

*S*s were informed about the general nature of the study but were not told that it was concerned with blushing until debriefing after the last session.

On the first day of the experiment the *S* first completed the BPS, whereafter she was asked to stand in front of both the video camera/television set and the experimenter, and sing "Happy Birthday" using facial and bodily expressions as much as possible.

During the second session, which was at least 2 days and at most 19 days after the first session, the *S* was asked to sit in a chair at a table in front of a television set. A photoplethysmograph probe was attached to the left cheek and a temperature probe was attached to the right cheek of the *S*. In addition, skin conductance electrodes were placed on the medial phalanges of the middle finger and

ring finger of *Ss*' non-dominant hand. The *S* was informed that these instruments would record physiological responses and that they would not cause pain. The *S* was instructed to watch the television screen and to move as little as possible. After each video segment, the *S* was asked to judge how she felt using 100 mm Visual Analogue Scales (VASs). The pertinent questions that participants had to answer on each occasion were "how much were you afraid to start blushing during the presentation of the video segment?" (ranging from 0 = "not afraid at all" to 100 = "very much afraid") and "how much did you blush during the presentation of the video segment?" (ranging from 0 = "I didn't blush at all" to 100 = "I blushed very much").

After the *S* had completed the VASs (after each segment), the experimenter entered the room to change the video tape in the videorecorder and to turn the sound on or off, depending on what segment would follow (during the presentation of the base-line material no sound was used). If the *S* talked to the experimenter, she responded in a neutral manner, without using words. Just before the stimulation started that was intended to produce blushing, the experimenter introduced two male confederates. During the "sing"-video the confederates remained in the lab and were seated to the side, between the *S* and the television set. These confederates were asked to judge, independent from each other, the *Ss*' blushing intensity. They rated the blushing intensity on a VAS (ranging from 0 = "she did not blush at all" to 100 = "she blushed very much")

Data reduction and analysis

All physiological parameters were analysed off-line by means of a specifically designed computer program. For both the first and the second baseline assessment, mean responses for all three physiological parameters (i.e. skin conductance level, facial temperature and facial coloration) were calculated by averaging the values on 4, 4.5 and 5 min. Then, for all three physiological measures difference scores were computed between the highest level during stimulation and the mean baseline response that preceded that stimulation. In addition, we took values at 40 sec after ending of the stimulation and subtracted mean baseline values from this value, to evaluate the rate of recovery.

The intensity of *Ss*' blushing reactions during the presentation of the fragment of her singing was judged by two confederates. The means of both ratings were used in the analyses.

The difference scores of all physiological and subjective measures (i.e. fear of blushing and self reported blushing intensity) were subjected to an Analysis of Variance (ANOVA) with two between-subjects factors (Group: High vs Low blushing propensity and Order: song first vs *Psycho* first) and one within-subjects factor (Stimulation: intended to produce blushing vs intended to generally arouse).

To examine the accordance between subjectively reported blushing and objectively observed blushing, Pearson's product–moment correlations were computed between raters' scores and *Ss*' scores of blushing during the "sing" video. In addition, Pearson correlations were calculated between raters' judgments of blushing reactions and *Ss*' physiological parameters. Finally, we explored the interrelationship between subjective blushing intensity and *Ss*' physiological responding. Therefore, Pearson product–moment correlations were computed between all three physiological difference scores (that is, the difference scores between the highest level during stimulation and the mean baseline response that preceded that stimulation) and *Ss*' self reported blushing intensity as indicated on a VAS.

RESULTS

Due to technical problems, no coloration data were available for three cases. For an additional three cases, recovery data on all three physiological measures were not available. This is reflected in the degrees of freedom. In Table 1, all outcomes are summarized.

Cheek coloration

A 2 (Group) × 2 (Stimulation) × 2 (Order) ANOVA on difference scores between mean baseline level and highest level during stimulation revealed a significant main effect for Stimulation, $F(1, 46) = 160.88$, $P < 0.05$. That is, *Ss* generally displayed more facial coloration during watching their singing than during watching psycho. No main effect of Group was found, $F(1, 46) = 0.30$, nor

Table 1. Mean differences between baseline and highest level during stimulation (stimulation) and mean differences between baseline and 40 sec after stimulation (recovery) in high and low BPS *Ss* for the song and *Psycho* video

		Song		*Psycho*	
		High	Low	High	Low
Coloration	Stimulation	3.6 (1.7)	3.4 (1.7)	0.61 (1.1)	0.44 (0.6)
	Recovery	1.5 (1.4)	1.4 (1.6)	0.04 (0.5)	11 (0.4)
Temperature	Stimulation	0.28 (0.33)	0.23 (0.27)	0.08 (0.21)	-0.03 (0.34)
	Recovery	0.52 (0.44)	0.41 (0.48)	0.03 (0.25)	-0.08 (0.41)
SCL	Stimulation	1.83 (1.00)	2.04 (0.85)	1.01 (0.69)	1.18 (0.78)
	Recovery	1.02 (0.72)	1.08 (0.63)	0.42 (0.44)	0.41 (0.45)
Fear of blushing		66.0 (27.0)	28.4 (25.9)	21.7 (21.5)	6.9 (11.7)
Subjective blush intensity		70.6 (23.7)	38.9 (26.3)	17.5 (18.1)	7.4 (9.4)
Raters' judgement of blushing intensity		46.0 (16.5)	39.1 (19.6)		

Temperature in C°.

a main effect of Order, $F(1,46)=0.08$. Contrary to our expectations, there was no significant interaction between Group and Stimulation, $F(1,46)=0.01$. Thus, the relative increase in coloration was similar for *Ss* with high and low BPS scores during the presentation of the "sing"-video. No other significant interaction effects emerged.

The ANOVA on the difference scores between mean baseline level and 40 sec after the end of the stimulation, revealed a significant main effect for Stimulation, $F(1,43)=44.11$, $P<0.05$, indicating that *Ss*' cheek coloration was still more increased 40 sec after the "sing"-video than 40 sec after Psycho. The retarded rate of recovery after the "sing"-video was not especially prominent in the high BPS group. That is, no interaction between Group and Stimulation appeared, $F(1,43)=0.30$. No other significant main or interaction effects appeared.

Temperature

By and large, temperature data showed the same pattern as the coloration data. A 2 (Group) × 2 (Stimulation) × 2 (Order) ANOVA on difference scores between mean baseline level and highest level during stimulation, revealed a significant main effect for Stimulation, $F(1,49)=18.75$, $P<0.05$, indicating that the temperature increase was generally stronger for the "sing"-video than for *Psycho*. No significant main effect of Group, $F(1,49)=2.22$, $P=0.14$, nor of Order, $F(1,49)=0.05$, emerged. Contrary to our expectations, there was no significant interaction effect between Group and Stimulation, $F(1,49)=0.03$. That is, both groups did not differ regarding their temperature changes, while watching both videos. A significant interaction effect emerged between Order and Stimulation, $F(1,49)=19.13$, $P<0.05$. *Post hoc* t-tests indicated that in order one (the "sing"-video before *Psycho*) *Ss* showed an increase in temperature during watching the "sing"-video whereas a slight decrease was found during watching *Psycho* [$t(25)=4.67$, $P<0.05$, means being 0.04 and -0.01]. In order two, where *Psycho* was shown first, there were no significant differences in temperature changes between the two kinds of stimulation [$t(26)=-0.01$, means being 0.01 for both kinds of stimulation]. The order effect is due to the fact that skin temperature was generally increasing (stabilizing) during the session. Skin temperature changes are relatively slow, as compared to coloration changes. When blush stimulation was given first, temperature increased more, above the general increase, in that first part and because it had risen to a maximum, it was able to decrease during *Psycho*. However, when *Psycho* was shown first, skin temperature was generally increasing in order to stabilize and at the time of the second part of the experiment, during the blush stimulation, facial temperature could not rise much further.

The ANOVA on the difference scores between mean baseline level and 40 sec after the end of the stimulation, again revealed a significant main effect for Stimulation, $F(1,46)=41.34$, $P<0.05$, indicating that *Ss*' temperature 40 sec after the stimulation was still more increased 40 sec after the "sing"-video than 40 sec after *Psycho*. Contrary to our expectations, there was no significant interaction between Group and Stimulation, $F(1,46)=0.08$. A significant interaction effect between Stimulation and Order, $F(1,46)=12.08$, $P<0.05$, was found, however. This reflects the spurious finding that the differences in recovery rate between both stimulations was especially prominent in order one (song first). No other significant main or interaction effects emerged.

Skin conductance

A 2 (Group) × 2 (Stimulation) × 2 (Order) ANOVA on difference scores between mean baseline level and highest level during stimulation showed, again, a significant main effect for Stimulation, $F(1,49)=90.33$, $P<0.05$. That is, *Ss* showed generally greater skin conductance level elevations during the stimulation intended to produce blushing than during the other type of stimulation (mean elevations being 1.9 and 1.1, respectively). No significant main effect of Group, $F(1,49)=1.08$, $P=0.30$, nor of Order, $F(1,49)=0.86$, $P=0.36$, emerged. Again, there was no significant Group × Stimulation interaction, $F(1,49)=0.05$. Yet, a significant interaction effect between Group and Order was found, $F(1,49)=4.30$, $P<0.05$. This reflects the accidental finding that the low BPS group displayed relatively large SCL increases for order 1 (song first), whereas high BPS *Ss* displayed relatively large SCL increases for order 2 (*Psycho* first). No other significant effects were found.

The ANOVA on the difference scores between mean baseline level and 40 sec after the end of the stimulation, again revealed a significant main effect for Stimulation, $F(1,46)=61.03$, $P<0.05$, which indicates a slower recovery rate after the presentation of blush-inducing material than after *Psycho*. Again, there was no significant Group × Stimulation interaction, $F(1,46)=0.00$. Yet, again a significant interaction effect between Group and Order was found, $F(1,46)=4.57$, $P<0.05$. This reflects the spurious finding that the low BPS group displayed relatively retarded recovery rates in order 1 (song first), whereas high BPS *Ss* displayed relatively retarded recovery rates in order 2 (*Psycho* first).

Self report measures

Fear of blushing. A 2 (Group) × 2 (Stimulation) × 2 (Order) ANOVA on subjectively reported fear of blushing revealed a significant main effect for group, $F(1,49)=27.24$, $P<0.05$, and for Stimulation, $F(1,49)=84.52$, $P<0.05$. In line with our predictions, a significant interaction effect between Group and Stimulation was found, $F(1,49)=11.07$, $P<0.05$.

These results indicate that *Ss* with high BPS scores were generally more afraid to blush than *Ss* with low BPS scores, and especially so during the presentation of their song. The main effect of Stimulation indicates that *Ss* were generally more afraid to start blushing during the presentation of their song, compared to the presentation of *Psycho*.

Blushing intensity. A 2 (Group) × 2 (Stimulation) × 2 (Order) ANOVA on subjectively reported blushing intensity revealed significant main effects of both Group, $F(1,49)=23.0$, $P<0.05$, and Stimulation, $F(1,49)=158.0$, $P<0.05$, and a significant interaction effect between Group and Stimulation, $F(1,49)=11.59$, $P<0.05$. These results implicate a stronger subjective feeling of blushing in general in *Ss* with high BPS scores, as compared to *Ss* with low BPS scores, and especially so during the presentation of their song. Furthermore, it indicated that all *Ss* had the idea that they blushed more during the presentation of their song.

Raters' judgements

Mean raters' judgement about *Ss*' blushing intensity was similar for both groups, $t(51)=-1.40$, $P=0.17$ (see also Table 1). There was a significant correlation between raters' blushing judgements and *Ss*' blushing judgements within the group with low BPS scores ($r=0.62$; $P<0.05$). In contrast, no such correlation was found between raters' blushing judgements and *Ss*' blushing judgements within the group with high BPS scores ($r=-0.24$, $P=0.23$). Thus, for low BPS *Ss*, perceived blushing intensity was strongly related to observed blushing intensity, whereas for high BPS *Ss*, this relationship was absent. Interestingly, *t*-tests indicated that self reported blushing intensity of the low BPS *Ss* was not only linearly related but also similar to that of the raters [$t(25)=0.05$, $P=0.96$, see also Table 1], whereas self reported blushing intensity of the high BPS *Ss* differed significantly from that of the raters [$t(26)=-4.0$, $P<0.05$, see also Table 1].

Physiological measurements, raters' judgements and subjective judgements of blushing intensity

For neither group were there significant correlations between physiological indices of blushing and self reported blushing intensity on the one hand, and raters' judgement about blushing intensity on the other hand. This finding suggests that changes in physiological parameters, such as changes in coloration as measured plethysmographically, are not easily detected by either raters or *Ss*.

DISCUSSION

The major results can be summarized as follows:

1. Physiological indices of blushing (i.e. blood flow and skin temperature) indicated that the female undergraduates blushed more intensely when watching their own "sing"-video than when watching *Psycho*.
2. There were no differences in this respect between *S*s with high and low blushing propensity (BPS).
3. However, high BPS *S*s were more afraid to start blushing and reported that they blushed more intensely than low BPS *S*s. In other words, high BPS *S*s overestimated their blushing reaction.
4. Finally, for neither group were there significant correlations between self-reported blushing intensity and physiological indices of blushing.

The present finding that *S*s blushed more intensely during the "sing"-video than during *Psycho*, is in accordance with previous studies of Shearn and colleagues (Shearn *et al.*, 1990, 1992). This pattern was evident for the skin temperature of the cheek as well as for *S*s' cheek coloration. In line with the physiological registration, the *S*s also reported that they blushed more intensely during the song than during *Psycho*. Yet, in contrast to our expectation, the blush reactions as indexed by changes in blood flow and observed reddening were similar for *S*s with high and low BPS scores. In other words, *S*s who reported that they blushed relatively often did not react with stronger blood flow responses or with a slower recovery rate than *S*s who reported blushing only seldomly. In addition, no differences were evident with respect to the temperature responses of both groups. Thus, the differential BPS scores neither referred to differences in observable components of the blush response during the "sing"-video nor to differences in the intensity of interoceptive cues related to blushing (i.e. increased skin temperature of the cheek).

One explanation for the absence of a differential response pattern for high and low BPS *S*s with regard to their blushing response might be that our manipulation (i.e. watching one's own "sing"-video) has been too strong. That is, it may be that such a situation makes most people blush, thereby masking the individual differences between high and low BPS *S*s. In other words, the absence of a difference between high and low BPS *S*s might be due to a "ceiling effect" for blushing reactions. The present experimental set-up provides a possibility to tentatively explore this issue. That is, it seems reasonable to argue that the mere presence of confederates is a relatively mild social stressor, which might more sensitively index between groups differences than watching one's own "sing"-video. As, in the current experiment, *S*s' physiological responding was registered continuously, it was possible to (*post hoc*) investigate the influence of the mere presence of the two confederates (i.e. just before the video started) on *S*s' cheek temperature and coloration. To explore this issue, we carried out two additional analyses. More specifically, we conducted a 2(Group: high/low BPS) × 2(Moment: baseline/confederates present) ANOVA for both cheek temperature and coloration.* The results indicate that *S*s generally reacted with increased cheek coloration and temperature in the presence of the confederates. Most pertinent to the present context, there was a borderline significant interaction between Group and Moment for *S*s' cheek coloration, indicating that high BPS *S*s reacted with more facial coloration than low BPS *S*s. Thus, the present findings provide some tentative evidence for the idea that high BPS *S*s, indeed, have a tendency to blush more intensely in case of relatively mild social stressors.

During the "sing"-video, high BPS *S*s reported a stronger blushing reaction than low BPS *S*s, whereas no differences between both groups were reported by the confederates and no differences were evident at the physiological level (see supra). Moreover, for the low BPS *S*s self reported blushing intensity and observers' judgements were highly similar, whereas the self reported blushing intensity of the high BPS group was much higher than those of the observers. The present finding

*Two separate 2(Group) × 2(Moment) ANOVAs showed no main effects of Group for either coloration, $F(1,48)=1.30$, $P=0.26$, or temperature, $F(1,51)=0.00$. There were significant main effects of Moment for both coloration, $F(1,48)=57.91$, $P<0.05$, and temperature, $F(1,51)=4.60$, $P<0.05$. For facial coloration, the analysis revealed a borderline significant interaction effect of Group and Moment, $F(1,48)=2.78$, $P=0.10$. There was no significant interaction effect of Group and Moment for temperature, $F(1,51)=1.68$, $P=0.20$.

that high BPS *S*s not only overestimated their blushing intensity but also reported to be much more afraid to start blushing than low BPS *S*s suggests, that their estimation of blushing frequency (as indexed by the BPS) may be inflated by a fearful preoccupation with blushing (cf. Bögels *et al.*, 1996). That is, such a preoccupation may lower the threshold for perceiving interoceptive cues and/or may lead to an overrepresentation of "blush events" in memory. In line with this suggestion, several studies have demonstrated that self-focused attention increases *S*s' awareness of physiological reactions and causes a tendency to overestimate the intensity of such arousal (see for a review, Scheier, Carver, & Mathews, 1983).

Following this line of reasoning, it can be argued that the strong relationship which has been demonstrated between blushing propensity and fear of blushing (e.g. Bögels *et al.*, 1996) might not be merely due to the fact that high blushing propensity is a vulnerability factor for the etiology of fear of blushing, but that fear of blushing results in a high blushing propensity. To further explore this issue, it would be interesting to see whether the present results can be replicated if *S*s are selected on the basis of their fear of blushing rather than on the basis of their blushing propensity and whether manipulation of attentional focus differentially affects *S*s with high and low fear of blushing. If so, such results would sustain clinical interventions that are designed to reduce self-consciousness or preoccupation with blushing (e.g. Bögels, Mulkens, & de Jong, under review).

Taken together, the present findings clearly showed that high BPS *S*s overestimate their blushing intensity. In addition, the present data tentatively suggest that high BPS *S*s, indeed, have a tendency to show relatively strong coloration reactions in case of mild social stressors. In other words, higher scores on the BPS seem to reflect both a fearful preoccupation and a stronger facial coloration. Further research employing social stimulations with varying intensity are necessary to more definitely settle this issue.

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