When gushing leads to blushing: Inflated praise leads socially anxious children to blush

Nikolić , M.; Brummelman, E.; Colonnesi, C.; de Vente, W.; Bögels, S.M.

DOI
10.1016/j.brat.2018.04.003

Publication date
2018

Document Version
Final published version

Published in
Behaviour Research and Therapy

Behaviour Research and Therapy 106 (2018) 1–7

Contents lists available at ScienceDirect

Behaviour Research and Therapy

journal homepage: www.elsevier.com/locate/brat

When gushing leads to blushing: Inflated praise leads socially anxious children to blush

Milica Nikolić[a,*], Eddie Brummelman[a,b], Cristina Colonnesi[a], Wieke de Vente[a], Susan M. Bögels[a]

[a] Research Institute of Child Development and Education, University of Amsterdam, The Netherlands
[b] Department of Psychology, Stanford University, USA

ARTICLE INFO

Keywords:
Blushing
Praise
Social anxiety
Late childhood

ABSTRACT

Blushing is an involuntary reddening of the face that typically occurs when people are concerned about making negative impressions on others. Although people typically blush for their mishaps or misdeeds, Darwin observed that some people, and especially children, also blush when they are lavished with praise. We theorize that socially anxious children blush when praised in inflated ways because they believe they do not match the inflated image others hold of them. Such praise-induced blushing might be particularly common in late childhood, when children's worries about their social image escalate. In this randomized experiment, 105 children (ages 8–12, 85% Caucasian) sang in front of an audience. Afterwards, children received inflated praise ("You sang *incredibly* well!"), noninflated praise ("You sang well!"), or no praise. Children's physiological blushing was assessed through photoplethysmography and a temperature sensor. As predicted, inflated praise—but not noninflated praise—increased blushing in socially anxious children. This emerged for blood pulse amplitude changes (AC reactivity) and self-reported blushing, not for blood volume (DC reactivity) and temperature changes. Socially anxious children may blush to "apologize" in advance for not being as incredible as others think they are. Thus, blushing may be elicited in situations that seem benign but actually evoke the fear of being evaluated negatively.

1. Introduction

> "Many children, as well as old and sensitive persons blush, when they are much praised" (Darwin, 1872, p. 327, p. 327)

To survive in the everyday social world, people have to attend to the social norms and rules of their social group. When they break these norms and rules, they may blush. Blushing, "the most human of all expressions" (Darwin, 1872, p. 309), is an innate biological response that typically occurs when people are concerned about making negative impressions on others (Leary & Meadows, 1991). That being the case, it is surprising that, as Darwin (1872) observed, some people, and especially children, even blush when there is no indication of wrongdoing, namely when they are lavished with praise. In a randomized experiment using physiological assessments of blushing, we put this possibility to its first empirical test. We focused on the key phase of late childhood (ages 8–12), when blushing becomes especially common.

1.1. Causes and nature of blushing

Blushing involves an instant reddening of the face due to an accumulation of blood in the superficial venous plexus of the facial skin in socially charged situations (Drummond, 1997, 2013; Leary & Meadows, 1991). Darwin (1872) suggested that it is "the thinking what others think of us, which excites a blush" (p. 327). Indeed, a growing body of work shows that people blush when they feel that there is a possibility of making a negative impression on people whose approval they seek (De Jong & Dijk, 2013; Leary, Britt, Cutlip, & Templeton, 1992). For example, people blush when they feel exposed, such as when they are caught tripping over their own feet or wearing the wrong outfit to a formal event (Crozier, 2004; Leary et al., 1992). In these contexts, blushing has a social function: It communicates to others that we share their rules and norms and that we care about their judgments, thereby appeasing others and minimizing their disapproval (Castelfranchi & Poggi, 1990; De Jong, 1999).

The ability to blush arises in early childhood, when children become able to see themselves as an object of social evaluation (Lewis, 1995; 2000). Consequently, they start evaluating themselves through the eyes of others (Leary et al., 1992; Lewis, 2000), which can lead them to blush when they fear that others may evaluate them negatively (Leary et al., 1992). Blushing then becomes especially common in late

* Corresponding author. Nieuwe Achtergracht 127, 1018 WS, Amsterdam, the Netherlands.
E-mail address: m.nikolic@uva.nl (M. Nikolić).

https://doi.org/10.1016/j.brat.2018.04.003
Received 30 June 2017; Received in revised form 8 April 2018; Accepted 18 April 2018
Available online 19 April 2018
0005-7967/

childhood, when children strongly desire to make favorable impressions on others and fear making unfavorable ones (Beidel & Turner, 1988; Westenberg, Drewes, Goedhart, Siebelink, & Treffers, 2004).

1.2. Blushing and praise

Scholars have speculated that children may blush when they are praised by others (Darwin, 1872; Leary et al., 1992). In Western societies, praise is among the most common types of feedback that children receive (Brummelman, 2018; Dijkstra, Kuyper, van der Werf, Buunk, & van der Zee, 2008). Parents, teachers, and educators often give children overly positive, inflated praise (Brummelman, Crocker, & Bushman, 2016; Brummelman, Thomaes, de Castro, Overbeek, & Bushman, 2014). For example, rather than telling children that they performed well, they may tell them that they performed *incredibly* well. But inflated praise may not affect all children equally. As Darwin (1872) noted, it may be especially consequential for those who are sensitive to other people's opinions: socially anxious children.

Social anxiety refers to the fear of being judged negatively by other people in social situations in which the person is exposed to the scrutiny and evaluations of others (American Psychiatric Association, 2013). Socially anxious children are especially prone to blushing in aversive social settings, such as performing in front of others, because they fear making an unfavorable impression (Nikolić, Colonnesi, de Vente, & Bögels, 2016). According to the cognitive model of social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997; Voncken, Bögels, & de Vries, 2003), socially anxious individuals underestimate their own abilities and overestimate others' expectations of them, and therefore fear not being able to meet others' expectations. Because of this fear, they often seek appeasement and blush frequently (Bögels et al., 2010; Stein & Bouwer, 1997).

When socially anxious children are praised in inflated ways, they may feel overwhelmed. They could perceive the praise as undeserved (Castelfranchi & Poggi, 1990; Crozier, 2001, 2004) and may believe that they cannot live up to the inflated image others have of them (Brummelman et al., 2014), and thus fear others' negative evaluations of them (Wallace & Alden, 1997). They may blush to apologize, nonverbally, for not being as incredible as other people think they are. By contrast, when socially anxious children are praised in noninflated ways, they may believe that the praise sets a reasonable standard for them. Thus, they may believe they can live up to the praise, and have no reason to blush. Although this hypothesis has never been tested directly, indirect evidence suggests that being lavished with praise may lead socially anxious individuals to fear social rejection (Alden & Wallace, 1995; Wallace & Alden, 1997; Weeks, Heimberg, Rodebaugh, Goldin, & Gross, 2012).

1.3. Physiological blushing

Existing research has predominantly measured blushing through self-report. However, people often underestimate or overestimate their blushing. Socially anxious individuals, for example, routinely overestimate their actual blushing (Nikolić, Colonnesi, de Vente, Drummond, & Bögels, 2015). Overcoming this limitation of self-report, we measured children's actual, physiological blushing response. Physiological blushing is reflected in cheek blood flow and temperature (Cooper & Gerlach, 2013; Shearn, Bergman, Hill, Abel, & Hinds, 1990). Blood flow can be assessed through photoplethysmography, which has two components: alternating current (AC) and direct current (DC). Its fluctuating AC component reflects blood pulse amplitude (i.e., blood volume change with each heartbeat), which acts quickly (Swain & Grant, 1989). Its DC component reflects the average level of blood volume and represents blood pooling in the arteries, veins, and capillaries, which acts slowly (Allen, 2007). In addition, changes in cheek temperature, which are caused by increases in blood flow and consequent vasodilation and occur later than changes in blood flow, can be assessed through a temperature sensor (Peper, Harvey, Lin, Tylova, & Moss, 2007). Thus, blood pulse amplitude (AC) indexes immediate changes in blushing, whereas blood volume (DC) and temperature changes index slowly emerging changes (Cooper & Gerlach, 2013).

1.4. Present experiment

Here, we report a randomized experiment in which we examined, for the first time, whether inflated praise leads socially anxious children to blush. We focused on the key age of late childhood (ages 8–12). Children and their parents first completed well-established questionnaires of children's social anxiety. Children were then invited to sing a song on stage in front of a small audience. Afterwards, a "professional singer" gave them inflated praise, noninflated praise, or no praise at all. We measured children's blushing by assessing blood pulse amplitude (AC), blood volume (DC), and temperature changes in the cheek. We hypothesized that inflated praise would increase blushing in socially anxious children.

2. Method

2.1. Participants

Participants were 105 children (56% girls) aged 8–12 (Mage = 9.50 years, SD = 1.18 year; 85% Caucasian) recruited through public elementary schools in the low to upper-class neighborhoods in the Netherlands to take part in a larger study about socio-cognitive and physiological indices of social anxiety. They were accompanied by one of their parents (77% mothers) aged 25–60 (Mage = 43.00 years, SD = 6.15 years), who had relatively high educational levels (M = 3.50, SD = 0.65, from: 1 = *primary school degree*, 2 = *secondary school degree*, 3 = *college degree*, to 4 = *university degree or higher*). Parents provided active informed consent for their children and for themselves. The study was approved by the Ethics Review Board of the University of Amsterdam.

We selected our sample size to achieve sufficient statistical power. Based on previous research on contextual effects on blushing in socially anxious individuals (e.g., Drummond et al., 2003), we expected a moderate-sized interaction between praise and social anxiety on blushing. Power analysis showed that our sample size ensured sufficient power (0.89) for detecting a moderate-sized interaction (α = 0.05, two-tailed; Champely, 2015; Cohen, 1988).

2.2. Procedure

Social anxiety. Children visited the Family lab of the University of Amsterdam with one parent. Both the child and the parent completed the Social Phobia Anxiety Inventory, a well-established questionnaire to index child's social anxiety (child report: SPAI-C, Beidel, Turner, & Morris, 1998; Utens, Ferdinand, & Bögels, 2000; parental report: SPAI-C-P, Beidel, Turner, Hamlin, & Morris, 2001). Both versions of the questionnaire consist of 26 items and a 3-point Likert response scale (0 = *never*, 2 = *always*; child report: M = 0.45, SD = 0.32, Cronbach α = 0.96; parental report: M = 0.44, SD = 0.34, Cronbach α = 0.94). Sample items include: "I feel anxious when I am with other girls, boys, or adults and I am in the center of attention (when everyone is looking at me)" in the child report version and "My child feels anxious when she/he is with other girls, boys, or adults and she/he is in the center of attention (everyone is looking at her/him)" in the parent-report version. Because child report and parent report were correlated, r (99) = 0.50, $p < .001$, we standardized the scores and averaged them into a composite. Results remained the same when child-report and parent-reported scores were analyzed separately (see Robustness Analyses).

Praise. After completing the questionnaires, parents were asked to stay in the waiting room while children joined the experimenter to the

Fig. 1. Experimental setting. Children first performed in front of an audience (left panel) and were then praised by the "professional singer" (right panel).

lab room. Children were invited to stand on the stage and sing a song of their choosing, in front of a two-person audience: the experimenter and a camera-woman, who was taping the entire performance with a classic movie-style camera (see Fig. 1). Children were told that the recording of the performance would be watched by a "professional singer," who was waiting in another room. Children sang for about one minute and were then told that the camera-woman would bring the recording to the professional singer. After two minutes, the professional singer (who was blind to the study hypotheses) came into the room and told the children that she had watched their recorded performance. Children were randomly assigned to conditions. In the noninflated-praise condition (n = 31), she said: "You sang well!" In the inflated-praise condition (n = 37), she said: "You sang *incredibly* well!" In the control condition (n = 37), she did not praise children. Instead, she said: "I saw your performance and I heard you sing a song." Afterwards, participants were thoroughly debriefed and thanked for participation.

Blushing. Because this was the first study on physiological blushing in school-aged children, we included the physiological indices that have been proven to reliably index blushing in adults, namely blood pulse amplitude (AC), blood volume (DC), and cheek temperature (Cooper & Gerlach, 2013; Shearn et al., 1990). The blushing response to praise was measured with an infrared-reflective photoplethysmograph device that was both AC and DC coupled. The alternating current (AC) component represents blood pulse amplitude and the direct current (DC) component of the signal represents blood volume (Allen, 2007). The plethysmograph output signal was amplified and filtered (low-pass, 0.75 Hz, 12 dB/oct for the DC signal; high-pass, 0.5 Hz, 36 dB/oct for the AC signal). The DC and AC output signals were converted to arbitrary values in the range of 0–65535 (16-bit ADC) at a speed of 200 S/s. Cheek temperature was monitored unilaterally with a platinum PT1000 temperature sensor fastened to the skin on the cheekbone of the right cheek, next to the infrared probe of the plethysmograph transducer.

To control for individual differences in skin characteristics (Drummond, 2013), we calculated the percentage increase from the 2-min period before the praise to the first 30 s after the praise for all outcomes: blood pulse amplitude (AC reactivity), blood volume (DC reactivity) and cheek temperature (temperature reactivity).

We did not create a longer interval between singing and praise, because praise is typically given soon after the performance (Henderlong & Lepper, 2002). We used the 2-min period, rather than a shorter period, as baseline because longer baselines capture blushing more reliably (Cooper & Gerlach, 2013). Doing so, we followed standard procedures; existing research has similarly used a 2-min baseline or longer periods for physiological blushing (e.g., Drummond et al., 2007; Mulkens, Jong, Dobbelaar, & Bögels, 1999; Nikolić et al., 2016).

Because it was possible that socially anxious children blushed more during the singing phase and that the carry-over effects of this blushing occurred in the phase after singing but before the praise (see, for example, Drummond et al., 2007), we examined whether the 2-min period before the praise was influenced by blushing in the singing phase. We found that absolute blushing values in the 2-min period before the praise did not correlate with children's social anxiety levels for any of the blushing indices (all ps > .100). Thus, we ensured that this phase was not differentially influenced by social anxiety or blushing during the preceding singing phase.

Using the 30-s interval after the praise ensured that we captured fast and large changes in facial blood flow and temperature caused by blushing (Cooper & Gerlach, 2013; Gerlach, Wilhelm, Gruber, & Roth, 2001; Shearn et al., 1990). Blushing indexed as blood flow peaks within 15s after the onset of the blush (Gerlach et al., 2001; Shearn et al., 1990) and temperature rises even more slowly (Cooper & Gerlach, 2013). Accordingly, on average from before to after the praise, blood pulse amplitude (AC) increased 27% (SD = 48%), blood volume increased 5%, (SD = 28%), and check temperature increased 0.27%, (SD = 0.77%).

3. Results

Nine children were excluded from the analyses because (a) the expert did not follow wording of the condition the child was assigned to (e.g., saying "you sang well" instead of "you sang *incredibly* well") (n = 3); (b) the electrodes for blushing were not properly attached to the cheek (n = 1); (c) the child was younger than 8, the minimum age for inclusion (n = 1); or (d) the physiological equipment failed during the task (n = 4). Social anxiety levels did not differ between children who were excluded versus included in the analyses, $t(103) = 0.44$, $p = .658$, $d = -0.15$, 95% CI [-0.84, 0.53].

Social anxiety and temperature scores were normally distributed, but AC and DC reactivity were skewed. We logarithm-transformed them, which improved their distribution. There were no differences between conditions in age, gender, and social anxiety of children, Wilks' $\lambda = 0.94$, $F(6, 180) = 0.95$, $p = .460$, $d = -0.36$, 95% CI [-0.79, 0.08] for age, $d = -0.26$, 95% CI [-0.70, 0.17] for gender, and $d = 0.05$, 95% CI [-0.38, 0.49] for social anxiety, indicating successful random assignment. Gender was not related to AC, DC, temperature reactivity, or social anxiety, $F(4, 88) = 1.36$, $p = .253$, $d = 0.25$, 95% CI [-0.17, 0.66].

3.1. Main analyses

Table 1 reports descriptive statistics and raw correlations. We conducted three multiple linear regression analyses predicting AC, DC, and temperature reactivity with praise as two dummy coded variables (dummy 1: 1 = noninflated praise, 0 = otherwise; dummy 2: 1 = inflated praise, 0 = otherwise), social anxiety (continuous, standardized), and their interactions as predictors. For AC reactivity, there were no main effects of praise and social anxiety, $R^2 = 0.01$, $F(3, 92) = 0.38$, $p = .767$. Adding the interactions between praise and social anxiety to

Table 1
Descriptive statistics and correlations among the study variables.

	Total	IP	NIP	NC	Pearson's r	2	3	4
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*				
1. AC reactivity	27.27 (48.23)	22.62 (54.31)	27.21 (51.93)	31.20 (40.01)	Total	.18†	.07	-.05
					IP	-.26	.08	.40*
					NIP	.35†	-.24	-.15
					NC	.29†	.38*	-.39*
2. DC reactivity	5.24 (28.48)	2.65 (15.98)	12.53 (40.68)	1.09 (23.13)	Total	–	.03	-.07
					IP	–	.20	-.07
					NIP	–	-.19	-.17
					NC	–	.26	-.03
3. Temp. reactivity	0.27 (0.77)	0.28 (0.94)	0.19 (0.15)	0.31 (0.63)	Total	–	–	-.07
					IP	–	–	.00
					NIP	–	–	.14
					NC	–	–	-.40*
4. Social anxiety	−0.01 (1.02)	0.00 (1.11)	0.18 (1.07)	−0.18 (0.89)				

Note. IP = inflated-praise condition; NIP = noninflated-praise condition; NC = no-praise condition. Social anxiety is a composite score of the parent and child report. *$p < .050$; †$p < .100$.

Table 2
Parameter estimates for multiple regression models of social anxiety and praise condition predicting physiological blushing.

Model	Parameter	β	*SE*	95% CI	*p*
AC reactivity	Social anxiety	-.49	0.21	[-.90, −.07]	.021
	Noninflated praise	-.04	0.24	[-.52, .44]	.859
	Inflated praise	-.16	0.24	[-.64, .32]	.505
	Social anxiety x Noninflated praise	.32	0.28	[-.24, .88]	.259
	Social anxiety x Inflated praise	**.89**	**0.28**	**[.33, 1.00]**	**.002**
DC reactivity	Social anxiety	-.04	0.22	[-.47, .40]	.871
	Noninflated praise	.49	0.25	[-.02, .99]	.060
	Inflated praise	.12	0.25	[-.39, .62]	.644
	Social anxiety x Noninflated praise	-.19	0.29	[-.78, .39]	.515
	Social anxiety x Inflated praise	-.02	0.29	[-.59, .56]	.957
Temperature reactivity	Social anxiety	-.41	0.22	[-.84, .02]	.060
	Noninflated praise	-.11	0.25	[-.62, .39]	.650
	Inflated praise	.02	0.25	[-.48, .53]	.921
	Social anxiety x Noninflated praise	.56	0.29	[-.02, 1.00]	.059
	Social anxiety x Inflated praise	.42	0.29	[-.16, .99]	.154

Note. The condition was dummy coded (dummy 1: 1 = *noninflated praise, 0 = otherwise;* dummy 2: 1 = *inflated praise, 0 = otherwise*).

the model significantly improved the model, $R^2\Delta = 0.11$, $F(2, 90) = 5.39$, $p = .006$. As shown in Table 2, the interaction between social anxiety and inflated praise was significant. Simple-slope analysis indicated that, as predicted, social anxiety was associated with stronger blushing (AC reactivity) in the inflated-praise condition, $\beta = 0.40$, $SE = 0.18$, $p = .032$, bootstrapped 95% *CI* [0.03, 0.76], but was unrelated to blushing in the noninflated-praise condition, $\beta = -0.17$, $SE = 0.19$, $p = .377$, bootstrapped 95% *CI* [-0.55, 0.21]. Social anxiety was associated with weaker blushing in the no-praise condition, $\beta = -0.48$, $SE = 0.21$, $p = .021$, bootstrapped 95% *CI* [-0.90, −0.07]. Regions of significance (Johnson & Neyman, 1936) analysis demonstrated that, relative to noninflated and no praise, inflated praise increased blushing in children high in social anxiety ($M > 1.3$ *SD*) and decreased blushing in children low in social anxiety ($M < 0.5$ *SD*) (Fig. 2).

There were no effects of praise, social anxiety, or their interactions on blushing as indexed through DC and temperature reactivity (Table 2). Thus, inflated praise specifically impacted the fast-responding (AC) rather than the slow-changing (DC and temperature) component of blushing in socially anxious children.

3.2. Robustness analyses

To examine the robustness of our findings, we repeated the analyses separately for children's self-reported and parent-reported social anxiety (rather than their averaged score) and with raw AC and DC reactivity (rather than the logarithm transformed scores). All results remained the same, attesting to their robustness. Although not the main focus of our research, we assessed children's blushing through self-reports; the result replicates the pattern of results found for AC reactivity (see Supplemental Material).

4. Discussion

Almost 150 years ago, Darwin speculated that being praised excessively can cause people, and especially children, to blush. Our experiment put this hypothesis to its first empirical test. We focused on the key developmental phase of late childhood, when children start being especially concerned about others' evaluations of them. Children were invited to sing a song on stage in front of a small audience and were then praised in inflated ways, noninflated ways, or not at all. As predicted, inflated praise—unlike moderately positive, noninflated praise—causes children to blush, particularly those children who are highly socially anxious. This emerged for blood pulse amplitude changes (AC reactivity) and self-reported blushing, not for blood volume (DC reactivity) and temperature changes. Attesting to the specificity of this effect, inflated and non-inflated praise differed in just one word: “incredibly.” Our results are robust: They replicated across multiple informants of children's social anxiety and self-reported blushing. However, we found this effect for physiological blushing indexed as AC reactivity, but not as DC and temperature reactivity.

4.1. Theoretical implications

Our findings have novel implications for existing theories of blushing. Social attention theory of blushing holds that praise can lead people to blush because it puts them in the center of unwanted attention (Leary et al., 1992). Our findings suggest that inflated praise, but not noninflated praise, puts socially anxious children in the center of unwanted attention, leading them to blush. . Unlike noninflated praise, inflated praise conveys to children that others have inflated views of them. Because socially anxious children hold themselves in low regard (Rapee & Heimberg, 1997) and fear that others will reject them

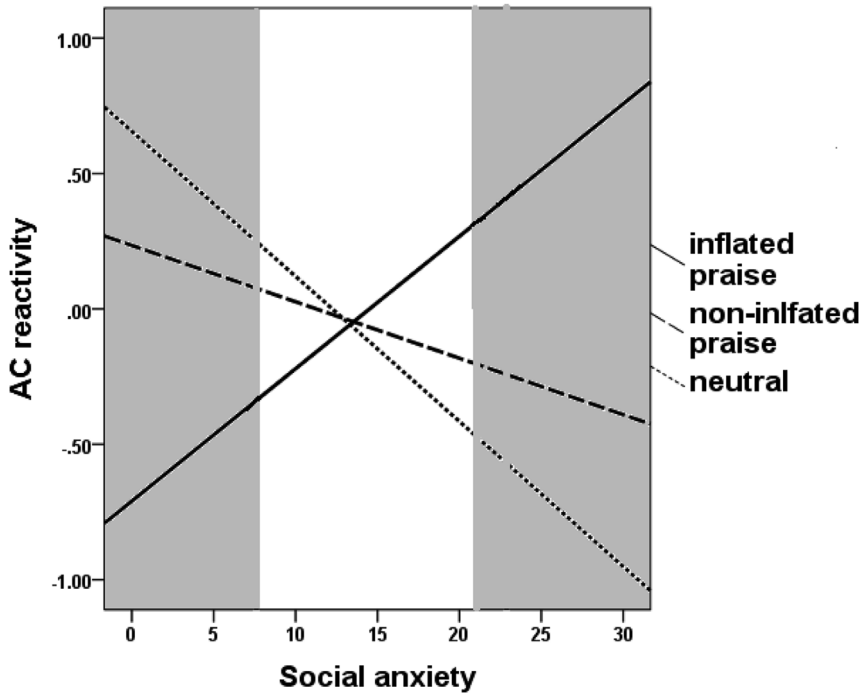

Fig. 2. The association between social anxiety and blushing (AC, blood pulse amplitude) in the inflated-praise, noninflated-praise, and no-praise condition. The gray areas represent the regions of significance: the scores of social anxiety at which inflated praise significantly affected blushing.

(American Psychiatric Association, 2013), inflated praise may feel undeserved and may seem discrepant from their self-image (Swann, 2012). They may fear that others will continue to expect from them to fulfill the high standards of inflated image in the future and that they will not be able to live up to these high standards (Alden & Wallace, 1995; Wallace & Alden, 1997). At the same time, socially anxious children may worry that others will evaluate them negatively because they socially transgress by accepting undeserved praise. As a result of these processes, socially anxious children may blush to appease others, thereby avoiding social rejection (Castelfranchi & Poggi, 1990; also see De Jong & Dijk, 2013).

An alternative interpretation is that socially anxious children, because of their lingering self-doubt (Rapee & Heimberg, 1997) and their tendency to interpret positive events negatively (Alden, Taylor, Mellings, & Laposa, 2008), may not believe that others honestly mean to praise them. Rather, they may think that others praise them insincerely or by mistake, which can make them feel foolish or embarrassed. These feelings can lead to blushing (Edelmann, 1985).

Past research shows that socially anxious children blush in response to experiences that are clearly aversive to them, such as speaking in public (American Psychiatric Association, 2013; Bögels et al., 2010; Nikolić et al., 2016; Nikolić, de Vente, Colonnesi, & Bögels, 2016). Our findings demonstrate, however, that socially anxious children can also blush in response to experiences that are seemingly benign, such as being praised in inflated ways. Interestingly, it seems that inflated praise makes socially anxious people feel at risk for social rejection as much as aversive social situations do, namely by raising the possibility that they will disappoint others or embarrass themselves in front of others.

Whereas most prior work relied on self-reported blushing or a single physiological index of blushing, we measured all its core physiological aspects. Inflated praise led to an increase in blood pulse amplitude (AC), but not in blood volume (DC) or cheek temperature. This was unexpected but may be explained by the fact that AC is the fast-changing component influenced by heart pulsations (Allen, 2007). By contrast, DC is the slow-changing component of plethysmograph output that reflects overall amount of blood in vessels (Allen, 2007). Cheek temperature changes even more slowly, only after the skin of the measured area has been influenced by the increases in blood flow (Cooper & Gerlach, 2013).

Our findings concur with those of prior studies, showing that social anxiety in children aged 4.5 relates to AC reactivity, which rises quickly, but not DC reactivity, which rises slowly (Nikolić et al., 2016). This may be because different measures of physiological blushing have a different time-offset (Cooper & Gerlach, 2013; Drummond, 2013). Some researchers also speculated that fast and slow changes in blood flow seem to arise from different physiological and psychological processes. Fast changes in blood flow may result from the quickly-acting active sympathetic vasodilatation (Drummond, 1997) and may reflect transient states of embarrassment marked by short blushes that disappear quickly (Voncken & Bögels, 2009) whereas more slowly occurring changes in blood volume may result from hormonal mechanisms (Drummond, 1997) and may reflect blushing that results from social stress due to a prolonged social exposure (Nikolić et al., 2016; Voncken & Bögels, 2009). In our study, the expert's inflated praise likely induced quick blushes of embarrassment, rather than blushing that reflected social stress due to prolonged exposure. Future research is needed to test the robustness of this pattern of results in different samples of children.

Two findings were unexpected. First, inflated praise reduced blushing in socially non-anxious children. These children are typically self-confident in social situations and expect others to have highly positive opinions of them (Ginsburg, La Greca, & Silverman, 1998). After performing, they may expect others to lavish them with praise; and when others do not, they may blush because they feel ashamed or humiliated. Second, children with higher social anxiety blushed less when not praised at all. Children were not informed beforehand that they would be evaluated by the singer; thus, the absence of praise may not have worried them. In fact, because socially anxious children are concerned with the possibility that they may be evaluated negatively (American Psychiatric Association, 2013; Ollendick & Hirshfeld-Becker, 2002), the absence of any evaluation (even if positive) could reduce their worries about being evaluated negatively, and thus reduce their blushing. Future research should replicate these findings and probe

their underlying processes directly.

4.2. Practical and clinical implications

Social anxiety is a common and prevalent phenomenon in Western societies that prevents youth from taking an active role in social life (Bögels & Stein, 2009). Socially anxious children avoid situations that make them feel uncomfortable (e.g., situations in which they blush, American Psychiatric Association, 2013), thus missing out on opportunities to overcome their anxiety. Although conventional wisdom holds that inflated praise should make them feel better about themselves (Brummelman et al., 2016), our study suggests that it makes them feel uncomfortable. Socially anxious children may desire to avoid such discomfort in the future, and therefore avoid settings in which they are in the center of attention and can be praised in inflated ways. Such avoidance can inadvertently maintain social anxiety. This concurs with recent research showing that being praised in inflated ways by parents leads children to develop lower self-esteem over time (Brummelman, Nelemans, Thomaes, & de Castro, 2017).

4.3. Strengths, limitations, and future research

Strengths of our study include its stringent and well-powered experimental design, its physiological assessment of blushing, its precise developmental timing, and its replication of results across multiple informants of children's social anxiety and across physiological and self-reported blushing. Our study also has limitations. First, our study was conducted in a typical Western country. Western society believes strongly in the power of inflated praise (Brummelman et al., 2016; Miller, Wang, Sandel, & Cho, 2002). Compared to children from Western countries, children from non-Western countries might not be used to being praised in inflated ways. Future research should examine whether the blush-inducing effects of praise are more pronounced in children from non-Western versus Western cultures. Second, in our study, children were praised by a “professional singer,” someone with authority in children's eyes. Because socially anxious individuals attach great weight to people's authority (Schlenker & Leary, 1982), they might be more likely to blush when praised by someone with versus without such authority. Future research should examine this possibility.

5. Conclusion

Our study reveals that socially anxious children blush not only because of mishaps and wrongdoings but also for the seemingly benign experience of being lavished with praise. They may blush to “apologize” in advance for not being as incredible as others think they are.

Conflicts of interest

The authors declare no conflict of interest.

Acknowledgments

This study was supported by an Innovation Research Vici NWO grant, number 453-09-001 to Susan M. Bögels. The writing of this article was supported, in part, by funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 705217 to Eddie Brummelman. We thank to Bert Molenkamp for his advice about physiological data processing, and Lisa van der Storm and Marielle van Loenen for their help with data collection.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.brat.2018.04.003.

References

Alden, L. E., Taylor, C. T., Mellings, T. M. J. B., & Laposa, J. M. (2008). Social anxiety and the interpretation of positive social events. *Journal of Anxiety Disorders, 4*, 577–590. http://dx.doi.org/10.1016/j.janxdis.2007.05.007.

Alden, L. E., & Wallace, S. T. (1995). Social phobia and social appraisal in successful and unsuccessful interactions. *Behaviour Research and Therapy, 33*, 497–506.

Allen, J. (2007). Photoplethysmography and its application in clinical physiological measurement. *Physiological Measurement, 28*, 1–39. http://dx.doi.org/10.1088/0967-334/28/3/R01.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Beidel, D. C., & Turner, S. M. (1988). Comorbidity of test anxiety and other anxiety disorders in children. *Journal of Abnormal Child Psychology, 16*, 275–287. http://dx.doi.org/10.1007/BF00913800.

Beidel, D. C., Turner, S. M., Hamlin, K., & Morris, T. L. (2001). The social phobia and anxiety inventory for children (SPAI-C): External and discriminative validity. *Behavior Therapy, 31*, 75–87. http://dx.doi.org/10.1016/S0005-7894(00)80005-2.

Beidel, D. C., Turner, S. M., & Morris, T. L. (1998). *Social Phobia and anxiety inventory for children: SPAI-C.* North Tonawanda, NY: Multi-Health Systems.

Bögels, S. M., Alden, L., Beidel, D. C., Clark, L. A., Pine, D. S., Stein, M. B., & Voncken, M. (2010). Social anxiety disorder: Questions and answers for the DSM-V. *Depression and Anxiety, 27*, 168–189. http://dx.doi.org/10.1002/da.20670.

Bögels, S., & Stein, M. (2009). Social phobia: Moving to DSM-V. In G. Andrews, G.,D. S. Charney, P. J. Sirovatka, & D. A. Regier (Eds.). *Stress-induced and fear circuitry disorders: Refining the research agenda for DSM-V* (pp. 65–83). Washington, DC: American Psychiatric Association.

Brummelman, E. (2018). Praise. In M. H. Bornstein (Ed.). *The Sage encyclopedia of lifespan human development*. Thousand Oaks, CA: Sage.

Brummelman, E., Crocker, J., & Bushman, B. J. (2016). The Praise Paradox: When and why praise backfires in children with low self-esteem. *Child Development Perspectives, 10*, 111–115. http://dx.doi.org/10.1111/cdep.12171.

Brummelman, E., Nelemans, S. A., Thomaes, S., & de Castro, B. O. (2017). When parents' praise inflates, children's self-esteem deflates. *Child Development, 88*, 1799–1809. http://dx.doi.org/10.1111/cdev.12936.

Brummelman, E., Thomaes, S., de Castro, B. O., Overbeek, G., & Bushman, B. J. (2014). “That's not just beautiful—that’s incredibly beautiful!”: The adverse impact of inflated praise on children with low self-esteem. *Psychological Science, 25*, 728–735. http://dx.doi.org/10.1177/0956797613514251.

Castelfranchi, C., & Poggi, I. (1990). Blushing as a discourse: Was Darwin wrong? In W. R. Crozier (Ed.). *Shyness and embarrassment: Perspectives from social psychology* (pp. 230–251). Cambridge, England: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511571183.009.

Champely, S. (2015). *Basic functions for power analysis. R package version 1.1-3. 2015.* Retrieved from: https://cran.r-project.org/web/packages/pwr/pwr.pdf.

Clark, D. M., & Wells, A. (1995). A cognitive model of social phobia. In R. G. Heimberg, M. R. Liebowitz, D. A. Hope, & F. R. Schneier (Eds.). *Social phobia: Diagnosis, assessment, and treatment* (pp. 69–93). New York, NY: Guilford Press.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Cooper, R., & Gerlach, A. L. (2013). Measurement of the blush. In W. R. Crozier, & P. J. De Jong (Eds.). *The Psychological significance of blush* (pp. 39–60). Cambridge, England: Cambridge University Press.

Crozier, W. R. (2001). Blushing and the exposed self: Darwin revisited. *Journal for the Theory of Social Behaviour, 31*, 61–72. http://dx.doi.org/10.1111/1468-5914.00146.

Crozier, W. R. (2004). Self-consciousness, exposure, and the blush. *Journal for the Theory of Social Behaviour, 34*, 1–17. http://dx.doi.org/10.1111/j.1468-5914.2004.00231.x.

Darwin, C. (1872/1998). *The expression of the emotions in man and animals.* New York, NY: Oxford University Presshttp://dx.doi.org/10.1037/10001-000.

De Jong, P. J. (1999). Communicative and remedial effects of social blushing. *Journal of Nonverbal Behavior, 23*, 197–217. http://dx.doi.org/10.1023/A:1021352926675.

De Jong, P. J., & Dijk, C. (2013). Social effects of facial blushing: Influence of context and actor versus observer perspective. *Social and Personality Psychology Compass, 7*, 13–26. http://dx.doi.org/10.1111/spc3.12009.

Dijkstra, P., Kuyper, H., van der Werf, G., Buunk, A. P., & van der Zee, Y. G. (2008). Social comparison in the classroom: A review. *Review of Educational Research, 78*, 828–879. http://dx.doi.org/10.3102/0034654308321210.

Drummond, P. D. (1997). The effect of adrenergic blockade on blushing and facial flushing. *Psychophysiology, 34*, 163–168. http://dx.doi.org/10.1111/j.1469-8986.1997.tb02127.x.

Drummond, P. D. (2013). Psychophysiology of the blush. In W. R. Crozier, & P. J. De Jong (Eds.). *The Psychological significance of blush* (pp. 15–38). Cambridge, England: Cambridge University Press.

Drummond, P. D., Back, K., Harisson, J., Helgadottir, F. D., Lange, B., Lee, C., ... Wheatley, L. (2007). Blushing during social interactions in people with a fear of blushing. *Behaviour Research and Therapy, 45*, 1601–1608. http://dx.doi.org/10.1016/j.brat.2006.06.012.

Drummond, P. D., Camacho, L., Formentin, N., Heffernan, T. D., Williams, F., & Zekas, T. E. (2003). The impact of verbal feedback about blushing on social discomfort and facial blood flow during embarrassing tasks. *Behaviour Research and Therapy, 41*, 413–425. http://dx.doi.org/10.1016/S0005-7967(02)00021-9.

Edelmann, R. J. (1985). Social embarrassment: An analysis of the process. *Journal of Social and Personal Relationships, 2*, 195–213. http://dx.doi.org/10.1177/0265407585022006.

Gerlach, A. L., Wilhelm, F. H., Gruber, K., & Roth, W. T. (2001). Blushing and

physiological arousability in social phobia. *Journal of Abnormal Psychology, 110*, 247–258. http://dx.doi.org/10.1037/0021-843X.110.2.247.
Ginsburg, G. S., La Greca, A. M., & Silverman, W. K. (1998). Social anxiety in children with anxiety disorders: Relation with social and emotional functioning. *Journal of Abnormal Child Psychology, 26*, 175–185.
Henderlong, J., & Lepper, M. R. (2002). The effects of praise on children's intrinsic motivation: A review and synthesis. *Psychological Bulletin, 5*, 774–795. http://dx.doi.org/10.1037/0033-2909.128.5.774.
Johnson, P. O., & Neyman, J. (1936). Tests of certain linear hypotheses and their application to some educational problems. *Statistical Research Memoirs, 1*, 57–93.
Leary, M., Britt, T., Cutlip, W., & Templeton, J. (1992). Social blushing. *Psychological Bulletin, 112*, 446–460. http://dx.doi.org/10.1037/0033-2909.112.3.446.
Leary, M., & Meadows, S. (1991). Predictors, elicitors, and concomitants of social blushing. *Journal of Personality and Social Psychology, 60*, 254–262. http://dx.doi.org/10.1037/0022-3514.60.2.254.
Lewis, M. (1995). Self-conscious emotions. *American Scientist, 83*, 68–78.
Lewis, M. (2000). The emergence of human emotions. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.). *Handbook of emotions* (pp. 265–280). New York, NY: Guilford Press.
Miller, P. J., Wang, S. H., Sandel, T., & Cho, G. E. (2002). Self-esteem as folk theory: A comparison of European American and Taiwanese mothers' beliefs. *Parenting: Science and Practice, 2*, 209–239. http://dx.doi.org/10.1207/S15327922PAR0203_02.
Mulkens, S., De Jong, P. J., Dobbelaar, A., & Bögels, S. M. (1999). Fear of blushing: Fearful preoccupation irespective of facial coloration. *Behaviour Research and Therapy, 11*, 1119–1128. http://dx.doi.org/10.1016/S0005-7967(98)00198-3.
Nikolić, M., Colonnesi, C., de Vente, W., & Bögels, S. M. (2016). Blushing in early childhood: Feeling coy or socially anxious? *Emotion, 16*, 475–487. http://dx.doi.org/10.1037/emo0000131.
Nikolić, M., Colonnesi, C., de Vente, W., Drummond, P., & Bögels, S. (2015). Blushing and social anxiety: A meta-analysis. *Clinical Psychology: Science and Practice, 22*, 177–193. http://dx.doi.org/10.1111/cpsp.12102.
Nikolić, M., de Vente, W., Colonnesi, C., & Bögels, S. M. (2016). Autonomic arousal in children of parents with and without social anxiety disorder: A high risk study. *Journal of Child Psychology and Psychiatry, 57*, 1047–1055. http://dx.doi.org/10.1111/jcpp.12563.
Ollendick, T. H., & Hirshfeld-Becker, D. R. (2002). The developmental psychopathology of social anxiety disorder. *Biological Psychiatry, 51*, 44–58. http://dx.doi.org/10.1016/S0006-3223(01)01305-1.
Peper, E., Harvey, R., Lin, I. M., Tylova, H., & Moss, D. (2007). Is there more to blood volume pulse than heart rate variability, respiratory sinus arrhythmia, and cardiorespiratory synchrony? *Biofeedback, 35*, 54–61.
Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy, 35*, 741–756. http://dx.doi.org/10.1016/S0005-7967(97)00022-3.
Schlenker, B. R., & Leary, M. R. (1982). Social anxiety and self-presentation: A conceptualization model. *Psychological Bulletin, 92*, 641–669. http://dx.doi.org/10.1037/0033-2909.92.3.641.
Shearn, D., Bergman, E., Hill, K., Abel, A., & Hinds, L. (1990). Facial coloration and temperature responses in blushing. *Psychophysiology, 27*, 687–693.
Stein, D. J., & Bouwer, C. (1997). Blushing and social phobia: A neuroethological speculation. *Medical Hypotheses, 49*, 101–108. http://dx.doi.org/10.1016/S0306-9877(97)90260-7.
Swain, I. D., & Grant, L. J. (1989). Methods of measuring skin blood flow. *Physics in Medicine and Biology, 34*, 151–175.
Swann, W. B., Jr. (2012). Self-verification theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Vol. Eds.), *Handbook of theories of social psychology: Vol. 2*, (pp. 23–42). London, England: Sage.
Utens, E. M. W. J., Ferdinand, R. F., & Bögels, S. M. (2000). *Dutch translation of SPAI-C (SPAI-C NL). Unpublished manuscript.* Rotterdam, the Netherlands: Department of Psychology, Erasmus University.
Voncken, M. J., & Bögels, S. M. (2009). Physiological blushing in social anxiety disorder patients with and without blushing complaints: Two subtypes? *Biological Psychology, 81*, 86–94. http://dx.doi.org/10.1016/j.biopsycho.2009.02.004.
Voncken, M. J., Bögels, S. M., & de Vries, K. (2003). Interpretation and judgmental biases in social phobia. *Behaviour Research and Therapy, 41*, 1481–1488. http://dx.doi.org/10.1016/S0005-7967(03)00143-8.
Wallace, S. T., & Alden, L. E. (1997). Social phobia and positive social events: The price of success. *Journal of Abnormal Psychology, 106*, 416–424.
Weeks, J. W., Heimberg, R. G., Rodebaugh, T. L., Goldin, P. R., & Gross, J. J. (2012). Psychometric evaluation of the Fear of Positive Evaluation Scale in patients with social anxiety disorder. *Psychological Assessment, 24*, 301–312.
Westenberg, M. P., Drewes, M. J., Goedhart, A. W., Siebelink, B. M., & Treffers, P. D. (2004). A developmental analysis of self-reported fears in late childhood through mid-adolescence: Social-evaluative fears on the rise? *Journal of Child Psychology and Psychiatry, 45*, 481–495. http://dx.doi.org/10.1111/j.1469-7610.2004.00239.x.