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Published in:
The Psychological Significance of the Blush

DOI:
[10.1017/CBO9781139012850.016](https://doi.org/10.1017/CBO9781139012850.016)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2009

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

De Jong, P. J., & Dijk, C. (2009). Signal value and interpersonal implications of the blush. In W. R. Crozier, & P. J. de Jong (Eds.), *The Psychological Significance of the Blush* (pp. 242-264). Cambridge University Press. <https://doi.org/10.1017/CBO9781139012850.016>

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12 Signal value and interpersonal implications of the blush

Peter J. de Jong and Corine Dijk

Introduction

Blushing is a highly common response and most people blush at least occasionally (Edelmann, 1990). A remarkable feature of the blush is that it may occur in many different types of situations: when spilling coffee on someone's trousers, when making a stupid remark during a meeting, when construction workers start whistling at you as you're passing, when being praised by your boss, when getting caught as you are about to leave the shop without paying, when someone bluntly asks if you have had sex lately, when being stared at, or just when the neighbour says hello to you. One may wonder: what is the common factor? And if there is a common factor, what is the meaning of the blush? Does it convey any relevant information about the blushing actor, about his or her traits or state, or about the situation in which the blush occurred? And if so, is the blush consistently associated with a particular mental/motivational state or just loosely coupled? Is it sufficiently consistent (within a particular context) to be useful for observers to infer relevant information about the actor?

In an attempt to arrive at some answers to all of these questions, we will first evaluate to what extent the blush can be considered as a meaningful, reliable signal. Subsequently, we will address the issue of what might in fact be signalled by the sudden reddening of the face: what type of information may be provided by a blush, what mental/motivational state can be inferred? Then we will discuss the potential social implications of displaying a blush. In the final section we will critically evaluate the empirical support for the signalling properties of the blush.

Is the blush a reliable signal?

Several theorists have hypothesized that blushing has signal value in interpersonal contexts (e.g., Burgess, 1839; de Waal, 1995). Some have even argued that the blush has distinct signalling properties and conveys particular information that would otherwise remain hidden from

observing others (e.g., Castelfranchi & Poggi, 1990; Frank, 1988). Indeed, several aspects of the facial blush invite speculation about its properties as a signalling device. First, although the blush may be elicited in many different types of situations, all of these situations imply the presence of other people (Leary & Meadows, 1991). So the least one can say is that in a typical blush-eliciting situation there is not only a transmitter (actor) but also a potential receiver (observer).

Another remarkable feature of the blush is that it typically expresses itself on the face (e.g., Simon & Shields, 1996). In fact, the specific physiological make-up which enables the blush response (e.g., beta-adrenergic receptors in facial veins) is restricted to this specific area of the human body (Mellander *et al.*, 1982; Wilkin, 1988): an area that is typically uncovered and at the centre of social attention (Darwin, 1872/1989). Since facial expressions play such a crucial role in human communication (e.g., Goffman, 1967), this feature of the blush provides further ammunition for the view that displaying a blush may have important social implications.

Moreover, there is evidence that humans are well equipped to perceive the blush. The visual system in humans has been found to be especially sensitive to colours in the frequencies reflecting the colour of oxygenated (i.e., arterial) and de-oxygenated (i.e., venous) blood (Changizi *et al.*, 2006). Thus, people seem ready for detecting subtle changes in blood circulation of the skin, and to differentiate between a reddening of the skin because of vasodilatation of facial arterioles (e.g., in the context of thermoregulation) and reddening because of vasodilatation of facial veins in the context of social blushing, although it should be noted that thus far this has never been put to the test. To the extent that the sudden vasodilatation of facial veins strongly correlates with a particular state (just as the reddening of the external female sex organs of a baboon is associated with being in a fertile state), this may provide people with the opportunity to infer a particular physical or mental/motivational state on the basis of the blush.

Germane to this, the ethologist Tinbergen (1952) argued that for a signal to be reliable it should be strongly correlated with a particular physical or mental state; it should be difficult to fake; and its absence may be taken as signalling the absence of the associated physical or mental state. At the very least, it seems beyond doubt that the sudden reddening of the face is extremely difficult to fake, and we guess that most people would agree that the blush can neither be intentionally elicited (when it would be efficient to pretend to blush) nor be intentionally suppressed (when it would be efficient to pretend not to blush). The exact nature of the mental/motivational state that is associated with

the blush might be more controversial. In the following section we will therefore explore whether this principle also applies to the blush response (see also Frank, 1988).

Signal value of the blush

Several approaches may help us to gain insight into the ‘blush-contingent’ mental/motivational state. First, it would be helpful to see what state is implied by writings about the blush. As a more direct approach, it would also be highly informative to know what feelings or emotions the actors themselves tend to report during blush-eliciting events. Third, one could catalogue the blush-eliciting events and see whether there might be any commonalities in the blush-eliciting antecedents that might inform us about the mental/motivational state of the blusher. Finally, it seems important to consider the underlying physiological mechanisms of the blush, as these might also provide important clues that help us to infer what mental/motivational state might co-occur with the acute reddening of the face. In the following sections we will use these various approaches to explore the critical features of the blush-contingent mental/motivational state.

Concurrent emotional feelings

Shame. In early religious texts such as the Bible, blushing is clearly linked to moral sentiments as reflected by the experience of shame. In line with the requirements of being a reliable signal, not only is the presence of a blush associated with the presence of moral sentiment (e.g., ‘... Oh, my God! I am ashamed, and blush to lift up my head to thee, my God.’, Ezra, 9:6), but also the absence of the blush is interpreted as implying the absence of moral sentiment (e.g., ‘... Are they ashamed of these disgusting actions? Not at all – they don’t even know how to blush!’, Jeremiah, 8:12). In one of the first scientific essays on the blush, Burgess (1839) also maintained that the blush reflects a moral sentiment. He argued that ‘blushing ... is a peculiar faculty of ... the internal emotions exhibiting themselves, for no individual blushes voluntarily; it would, therefore, appear to serve as a check on the conscience, and prevent the moral faculties from being infringed upon, or deviating from their allotted path’ (p. 24). He further maintained that the probable intent of the Creator, in endowing man with this peculiar property, was, that ‘the soul might have the sovereign power of displaying in the cheek, that part of the human body which is uncovered by all nations, the various internal emotions of the moral feelings whenever they are infringed upon either by accident or design, and that this

precaution had the salutary effect of enabling our fellow beings to know whenever we transgressed or violated those rules which should be held sacred, as being the bonds that unite man and man in the civilized state of social existence' (p. 49). Thus, Burgess's analysis seems to imply that the blush-contingent mental state is shame and/or the consciousness of guilt.

Shame and embarrassment before others. Darwin (1872/1989) also contended in his *The Expression of the Emotions in Man and Animals* that the blush is the signature expression of the self-conscious emotions such as shame and embarrassment. However, Darwin emphasized that the experience of a moral sentiment per se seems insufficient to elicit a blush. Accordingly, he noted, for example, that 'it is not the sense of guilt, but the thought that others think or know us to be guilty which crimsones the face ...' (p. 261). This important feature of the blush-contingent mental state is emphasized further in the work of Castelfranchi and Poggi (1990). They corroborate Darwin's view by pointing to the importance of differentiating between two types of shame: shame before others and shame before oneself. The critical difference between these types of shame is that only for shame before others is it critical that the actors assume that the observing others share the transgressed social rule. For example, only if the actor assumes that the observing others also find it very important to be exactly in time for a planned meeting will they feel shame before others when arriving a few minutes late. When they think that others are not very strict about this, they may still feel private shame upon arriving late, but not shame before others. Following Castelfranchi and Poggi (1990), the blush will only be evident in the former case as they assume that the blush will only occur if the actor experiences (also) shame before others.

They also noted two important prerequisites for arriving at this blush-eliciting state. First, they emphasized that shame before others will only arise before those whose esteem we seek. Thus, if a person is somehow indifferent about the judgment of the other persons who observe his or her violation of a particular rule, shame may be felt only before oneself but not before these others, and thus, in Castelfranchi and Poggi's (1990) view, blushing is not likely to occur. Second, they noted that it is critical that the actor assumes that the other person interprets the actor's behaviour as a transgression, even when in reality this may not be the case. Thus, even socially acceptable behaviour, such as comforting a colleague who has just heard very bad news by putting your arms around her, may still give rise to shame before others when the comforting actor assumes that a third person may misinterpret the situation as reflecting some kind of hidden love affair.

It seems relevant to note that in their analysis Castelfranchi and Poggi (1990) explicitly reserve the term 'shame' for the negative, painful mental state that is elicited when people regret or fear a loss of face following a transgression. Yet, others might argue that embarrassment, too, may be a blush-contingent state, depending on the type of social norm that has been violated (Keltner, 1995). Indeed there is evidence that people typically report feelings of embarrassment following less severe violations, or a breach of social conventions, whereas relatively severe flaws have been found to be more typically associated with feelings of shame (Tangney *et al.*, 1996). In the light of this, one would predict that blushing might be correlated with both feelings of shame and embarrassment (see also see Miller, this volume, Chapter 9; Scott, Chapter 10).

Consistent with this, people report blushing in both embarrassing and shameful situations (e.g., Shields *et al.*, 1990). In a similar vein, studies actually measuring the blush have shown that the blush can be elicited in embarrassing situations (e.g., being observed while singing a children's song; Shearn *et al.*, 1992) as well as in shameful conditions (e.g., upon transgression of a moral value; de Jong *et al.*, 2002). Interestingly, there is also evidence that it is not necessary to violate a rule oneself to reach a blush-contingent mental state; it has been shown that witnessing a significant other being involved in a self-presentational predicament may also give rise to an 'empathic' blush (Shearn *et al.*, 1999). In this case the blush may not only signify that the actor feels shame/embarrassment before others, but also that he/she feels strongly associated with the actual actor.

Antecedents

Violation of shared rules. In their analysis of conditions that may give rise to a blush, Castelfranchi and Poggi (1990) maintain that only violations of shared rules may give rise to the proper mental state that correlates with the blush. Thus far, it has not been directly tested whether a blush will indeed only occur following transgressions of *shared* social rules. There is, however, some indirect evidence from a vignette study which challenges this strong assumption (de Jong, 1999; experiment 3). In that study, we instructed participants to identify themselves with the actor, and used several scripts in which an observer saw the actor violate rules that are only complied with among restricted groups of the total population (e.g., 'One should not eat meat'). As the critical experimental manipulation, we systematically varied the actor's and observer's compliance with these rules and asked participants to estimate the probability that the actor (e.g., the one who ate the meat) would blush.

In line with the theoretical framework of Castelfranchi and Poggi (1990), the probability ratings of blushing were highest (i.e., 85 per cent) for the scenarios referring to violations of rules which were shared by the actors and the observers. Yet, in contrast to the idea that the blush response would only occur when the actor and the observer shared the violated rule, participants considered it also quite likely (approximately 50 per cent) that they would blush in the types of scenarios where only the observer or only the actor complied with the social rule. These results seem to suggest that the blush does not so much coincide with regret or fear because of having violated a shared rule, but rather with the more general regret or fear of making a negative social impression on the observer (e.g., as a result of violating one's own or the observer's rule) (cf. Leary *et al.*, 1992). Thus, it seems that the assumption of shared values is not a critical prerequisite for the blush to occur, and on the basis of the available evidence it seems most parsimonious to propose that the blush coincides with the more general feeling that one is thwarted in one's goals of esteem before others or that one is about to thwart them.

Undesired social attention. This seems also consistent with the conclusion of Leary and colleagues (1992; see also Leary & Toner, Chapter 4) that the various categories of situations in which people typically tend to blush all have in common that they are characterized by undesired social attention. Clearly, only if the actor is somehow subject to social attention can the other person become aware of the transgression. In the typical situation that one's goal of esteem before others is at stake this social attention will logically be undesired. Thus, it seems highly plausible that the blush often coincides with the experience of undesired social attention. Yet, there seems no perfect contingency between blushing and undesired social attention. First, one can think of situations involving undesired social attention which will probably *not* give rise to a blush. For example, consider a student who starts whistling at the distinguished professor when she enters the lecture hall, the famous television personality who is chased by paparazzi, the Olympic champion who is approached by pushy fans, or the girl who is playing the piano when her younger sister starts commenting on her skill, and so on. In such cases, undesired social attention is likely to result in irritation or even anger instead of blushing. Second, there also seem to be situations involving desired instead of undesired social attention that nevertheless can elicit a blush: for example, when a girl is asked out for a drink by the most handsome guy in the class, or when someone receives a deserved compliment from his or her superior. Of course in the latter cases the experienced social attention may become undesirable but not as an

antecedent condition, rather as a consequence of their blushing, since people typically dislike being caught while displaying a blush (Shields *et al.*, 1990). Thus, the strong view expressed by Leary *et al.* (1992) that undesired social attention is a necessary and sufficient feature of blush-eliciting situations is not beyond dispute.

Submissiveness. Meanwhile, both types of apparent exceptions seem helpful in specifying further the presumed blush-contingent mental/motivational state. First, the situations exemplifying 'no blush despite undesired social attention' seem to point to an important restricting condition: blushing seems not to occur if the actor is in a dominant/favourable position compared to the observing other (elder vs younger sister; professor vs student; champion vs fan). Thus, it seems that the actor not only needs to have a goal of esteem before the observing other and thus to care about his or her judgment, but also to be (experience being) in a subordinate position compared to the observer. This suggests that the blush co-occurs with a motivational orientation towards submissiveness (see also de Waal, 1995). The situations exemplifying 'a blush in the absence of undesired social attention' are also consistent with this suggestion. In both examples, the observing other seems to be in a dominant (supraordinate) position. Moreover, paying a compliment can perhaps even more generally be considered as an intrinsically dominant type of behaviour (apparently the sender has the authority to judge the actor's behaviour/accomplishment), which, therefore, may automatically place the receiver in a subordinate position.

Physiological characteristics

Finally, the specific physiological underpinning of the blush may also point to an important feature of the blush-contingent mental/motivational state. That is, the reddening of the face depends on a fast-acting neuronal system (see Drummond, Chapter 2). This may be taken to reflect that the blush relates to an acute awareness of an urgent threat that requires immediate action. In response to a typical external threat (e.g., an angry, barking dog) motivational systems are activated to sustain 'fight or flight' behaviours. Under these conditions the acute activation of the sympathetic branch of the autonomic nervous system can be explained as a functional reflex that sustains the metabolic requirements for these defensive responses. However, in the typical blush-eliciting situations, neither fight nor flight responses seem appropriate or helpful, and would probably even contribute further to loss of face

(see also Miskovic & Schmidt, Chapter 8, this volume). Perhaps, then, the activation of the sympathetic nervous system is due to the paradoxical situation that, on the one hand, the actor experiences a strong urge to flee (disappear, become invisible), while, on the other hand, the actor needs to inhibit this initial tendency, as such a response would make things even worse (cf. Crozier, 2006; Frijda, 1986). Clearly, this remains highly speculative as it is still a matter of debate how exactly the blush response has evolved and what physiological purpose lies at the heart of the activation of the sympathetic nervous system in the blush-eliciting situations (see van Hooff, Chapter 5). It seems nevertheless safe to conclude that the acute activation of the sympathetic branch that causes the reddening of the face indicates that the actor is subject to an acute and salient concern. Moreover, because it is virtually impossible to bring these autonomic responses under intentional control, the physiological underpinnings of the blush bear witness to the ‘sincerity’ of the actor’s response.

To conclude, facial blushing seems to share all the relevant properties of a reliable signalling device. It seems not only impossible to fake, it seems also to co-occur with a specific mental state: the acute awareness that one’s goal of esteem before the other is at stake together with the impulse to take a subordinate position.

Social implications of the blush

Theoretical speculations

Since the blush seems to fulfil all criteria of being a reliable signal (cf. Tinbergen, 1952), it may have acquired important interpersonal signalling functions. Accordingly, people may use the blush to understand the actors’ behaviours and to make inferences about the dispositional characteristics and/or emotional state of the actors. What exactly people might infer on the basis of the actor’s blush will logically be dependent on the context and social setting in which the blush is observed (cf. Costa *et al.*, 2001). For example, in the context of a self-presentational predicament (e.g., arriving apparently underdressed to a business meeting), the blush may be taken as a signal that the actor feels embarrassed, is aware of the fact that his or her behaviour is inappropriate or may be taken as inappropriate (violating the social standards), is sincerely bothered by the possibility that he/she has made a negative impression on the observer, and feels the urge to humbly apologize for this faux pas. In such a context the blush may well elicit

sympathy and serve as a remedial gesture in accordance with other displays of embarrassment such as touching the face or suppressing a smile (e.g., Keltner *et al.*, 1997).

Yet, in the context of a straightforward moral transgression people might make a slightly different type of inference, and the transgression may therefore also have different social consequences. When, for instance, people observe the actor blushing upon being caught attempting to leave the restaurant without paying, they may infer that the actor is aware that he or she has committed a serious transgression, does care about others' judgment, feels guilty, fears the social consequences of being caught (e.g., aggression), and feels the urge to express a submissive apology. The blush following a moral transgression may therefore inhibit aggression and elicit reconciliation-related behaviours (cf. Tangney *et al.*, 1996). The fact that blushing cannot be voluntarily produced seems of particular relevance in these contexts, as it prevents blushing from being used instrumentally. One might even argue that were opportunistic people able to simulate blushing, the blush response would eventually lose its specific communicative properties.

The fact that the blush cannot be voluntarily *suppressed* seems of particular relevance in another class of social contexts: social settings that are ambiguous with regard to the actor's behaviour (Crozier, 2004; see also Crozier, Chapter 11, this volume). For example, consider situations that may reflect a transgression, but not necessarily so, such as a person who starts blushing when he cannot find his train ticket when asked for it by a train authority. In their causal interpretation of the transgressor's behaviour, the observers will tend to over-emphasize the role of the actor's negative dispositions and to underemphasize the influence of situational factors (the fundamental attribution error; Ross, 1977). Due to the pervasive logical fallacy of 'affirmation of the consequent' (Evans *et al.*, 1993) (e.g., 'if a person does something undesirable, then that person will blush; the person blushes, thus the person must have done something undesirable'), observers might interpret blushing in the absence of a clear-cut antecedent of the blush response as a further confirmation of the undesirable (immoral) motives behind the actor's behaviour. Thus, the blush may lead observers to interpret ambiguous behaviour as reflecting an intentional (and thus unfair) act. In such a case the observer may, therefore, infer from the blush that the actor intentionally did not buy a ticket. In other words, the observer may use the blush to disambiguate the situation and may use the heuristic 'true innocence doesn't need a blush'. Hence in these cases the blush may be taken to reveal guilt.

Thus, although we propose that the blush always coincides with the acute awareness that one's goal of esteem before the other is at stake together with the impulse to take a subordinate position, its concrete signal value and/or the concrete interpersonal consequences of signalling this state seem highly dependent on the *context* in which the blush is elicited. Moreover, the inferences and social implications may also depend on the *characteristics of the observer*. For example, the signalling properties of the blush in interdependent situations may vary as a function of the observer's social value orientation. That is, one might expect that blushing has a different meaning for people who value cooperation and a fair distribution of resources (i.e., prosocials) than for people who are more inclined to work alone and to keep resources to themselves (i.e., 'proselfs'). Proselfs may infer from others' blushing that these individuals are exploitable, whereas prosocial individuals may use the blush to infer the actors' (lack of) trustworthiness (cf. Liebrand *et al.*, 1986).

Clearly, the literature on blushing is heavily dominated by speculations and conjectures whereas empirical research on social blushing is very scarce. There are nevertheless some empirical studies that have tested some of the hypotheses that have been put forward in this chapter. In the next section of this chapter we will discuss these studies in the light of the alleged signal value and social implications of the blush.

Empirical evidence

Clear-cut mishaps and moral transgressions. Because blushing cannot be voluntarily produced, it seems virtually impossible to specifically vary the actors' blush response as a function of experimental conditions under *in vivo* circumstances. Accordingly, the first studies that directly tested the alleged communicative properties of the blush used vignettes rather than real-time interactions. In a first attempt to empirically document the view that social blushing might serve a remedial function, participants were presented with a series of vignettes which described incidents that had taken place in a shop (e.g., a shopper pushes a vase from a shelf; cf. Semin & Manstead, 1982) and asked them to evaluate these situations as if they were shoppers observing the incident (de Jong, 1999). In the vignettes, the actor could show one of three types of responses: the actor just left the shop after the incident, the actor showed motoric signs of shame and left the shop, or the actor displayed a blush and left the shop. In line with the idea that blushing serves as a remedial gesture, participants rated the blushing actors as being more friendly as well as more reliable than their non-blushing

counterparts (de Jong, 1999, experiments 1 and 2). Also the incident itself was rated as less serious in the blush condition. In line with the view that the involuntary nature of the blush might strengthen its signal value, the remedial effects of blushing were more pronounced than those of motoric signs of shame.

An important limitation of these first studies was that the vignettes did not isolate the blush from the other features of an appeasement display. It can, therefore, not be ruled out that the participants in these experiments did not just imagine a reddening of the face (in the blush condition), but a complete emotional display including a blush. Thus, it remained to be tested whether merely blushing does indeed have remedial properties. Moreover, the vignettes explicitly described the actor's response. Asking participants about their judgment of the blushing actor thus requires people's explicit appreciation of this response. It might well be that the blush exerts its influence at a more implicit level. Hence, it remained to be tested whether indeed the blush may also elicit its remedial effect when the observers are not explicitly informed about the actor's blushing.

Therefore, a subsequent study (Dijk *et al.*, 2009) presented the participants with *photographs* of the actors (on a computer screen) rather than with an explicit description of the actor's response. As an additional issue, this study investigated whether the effects of the blush are restricted to contexts reflecting a mild social transgression which are typically associated with embarrassment, or whether similar effects could also be traced in the context of more severe transgressions such as hurting others emotionally or shortcomings in moral worth: conditions that are usually associated with shame (Keltner *et al.*, 1997). Therefore, in this study we used both vignettes representing obvious mishaps (e.g., bumping into a rack full of wine glasses; upsetting a pile of cans in the supermarket) and vignettes representing obvious moral transgressions (e.g., missing a funeral because of a party; driving away after crashing a car), along with displaying the actors in a photograph on the screen (Dijk *et al.*, 2009). Again, participants were instructed to imagine that they were the observer of the situation. The colour photographs consisted of the head and upper chest of models displaying shame, embarrassment or a neutral face (see Keltner *et al.*, 1997). For each facial expression, half of the photographs were manipulated to show a lifelike blush.

This subsequent study (Dijk *et al.*, 2009) also found that blushing has remedial properties. Importantly, displaying a blush on a neutral face positively affected the observers' judgments not only in the context of obvious mishaps but also in the context of transgressions. Specifically in

the context of moral transgressions, blushing also led to more positive observers' judgments when the blush was displayed on top of shame. This pattern of findings indicates that blushing indeed has signal value in addition to other facial expressions. For all displays a blush intensified the impression that the actor felt ashamed or embarrassed. Mediation analyses suggested that blushing might succeed in affecting the observer's judgment via the enhancement of the perceived intensity of the actor's shame or embarrassment. Thus, the blush seems to signal that one experiences the moral emotion relatively intensively, which subsequently might give rise to a more positive judgment. Because the available range of expressing shame/embarrassment via contraction of the relevant facial musculature is restricted, the blush might have useful complementary remedial value, especially when one has already reached a full-blown (muscular) expression of shame/embarrassment. Moreover, blushing might have complementary value by attesting to the apparent sincerity that one is ashamed or embarrassed, because it is impossible to control the blush intentionally.

To examine the differential signal value of the muscular facial expressions of the emotions versus the blush, we additionally examined the relative efficacy of a blush vis-à-vis the facial expressions of embarrassment or shame without a blush (Dijk *et al.*, 2009). Following a clear-cut transgression, a neutral but blushing face was rated as less ashamed than a facial expression of shame without a blush. However, merely displaying a blush elicited similar remedial effects to showing the facial expression of shame without a blush. The sincerity of the signal may be an explanation for this remedial effect of blushing. A sincere acknowledgment that one is aware of the wrongdoing may decrease the expectancy that the blushing individual will defect again (Gold & Weiner, 2000). Clearly, future research is necessary to test the robustness of these findings and to reach firmer conclusions about the mechanisms that underlie this effect of the blush on the observer's judgment.

Social implications in the context of ambiguous social situations

The situations described thus far in this section have reflected straightforward transgressions and mishaps. It remains to be seen, therefore, what type of information people might infer from the blush in more ambiguous situations that could reflect a transgression but not necessarily so. As we argued above, in such situations observers might well use the blush to disambiguate the situation and might tend to infer that the person may have done something undesirable ('true

innocence doesn't need a blush'). Thus, rather than having remedial properties, the blush would reveal 'guilt'.

As a first step to testing the validity of this hypothesis we again presented participants with a series of vignettes (de Jong *et al.*, 2003). Yet, in this study we not only used scenarios that referred to apparently involuntary mishaps and more serious moral transgressions, but also scenarios reflecting ambiguous situations that could be interpreted either as a transgression or as an accident. Corroborating the studies described in the previous section, the results of this subsequent vignette study again showed that blushing has favourable effects in the context of both a seemingly involuntary mishap and more serious and apparently voluntary moral transgressions (de Jong *et al.*, 2003). As hypothesized, similar remedial effects of blushing were completely absent in the context of more ambiguous social situations (de Jong *et al.*, 2003; experiment 1), or violations of socio-moral rules that were ambiguous with respect to the actor's intentionality (de Jong *et al.*, 2003; experiment 2). Thus, in the absence of clear-cut transgressions or straightforward information with respect to the intentionality of a transgression, blushing did not result in a more positive evaluation of the actor as was found in the context of a mishap or a voluntary moral transgression. Instead, in the absence of straightforward antecedent behaviour, blushing tended to further undermine rather than to sustain the actor's trustworthiness. Meanwhile, the incident itself was judged as being considerably more serious when the actor displayed a blush. All in all, it appears that in the ambiguous situations, displaying a blush may substantiate observers' lingering suspicions that the blusher has behaved in a socially inappropriate manner (cf. de Jong *et al.*, 2002).

Blushing in real-time interactions

The vignette studies described above clearly showed that blushing actors were judged differently than their non-blushing counterparts (de Jong, 1999; de Jong *et al.*, 2003; Dijk *et al.*, 2009). However, to demonstrate that blushing really influences social interactions, it would be critical to test the influence of the blush in concrete as well as in imagined interpersonal situations (e.g., Parkinson & Manstead, 1993). Testing the influence of blushing on interpersonal behaviours is notoriously difficult as it requires: (1) that the experimental manipulation reliably elicits a (visible) blush in the actors, (2) the presence of at least one other individual who may observe the blush and whose judgments and/or behaviour may be influenced by the blush, and (3) a (controllable) social interaction during which the potential influence of the actor's blush

response on the observer's behaviour can be reliably assessed. After extensive pilot work we eventually arrived at a modified and morally framed prisoner's dilemma game (PDG; de Jong *et al.*, 2002). A PDG¹ is characterized by the occurrence of two conflicting motives (cooperation vs defection) which individuals experience in interdependent situations. In such a context, moral concerns with respect to cooperation are likely to be strong (e.g., Kerr, 1995). Accordingly, it has been shown that prosocial individuals' response strategy is typically guided by the aim to maximize joint outcomes, and to restore equality in outcomes (van Lange, 1999). Thus, prosocials generally approach interdependent others in a cooperative manner and continue to do so until the interdependent other fails to exhibit cooperative behaviour (van Lange, 1999). When being cheated, prosocials typically turn to non-cooperation in a rather unforgiving manner (van Lange, 2000). Thus, after being cheated, prosocial individuals will tend to reciprocate by defecting themselves.

To test the impact of blushing on people's appreciation of defecting others as well as on their interpersonal behaviour we designed a ten-trial PDG and selected a homogeneous group of individuals sharing the important social goal of cooperation (i.e., prosocials; de Jong *et al.*, 2002). These individuals participated as pairs. To elicit a shameful transgression, for each pair, one individual was instructed to select the (for them non-habitual) defect-option on a pre-defined target trial (and to cooperate on all other trials). Of course the interdependent other was not aware of this instruction. Within this particular context we tested whether the interdependent other would evaluate the defector less negatively as a function of the defector's blush intensity and if the prosocial victim's habitual tendency to reciprocate cheating behaviour (cheat him- or herself on the next trial) would be attenuated by the defector's blush response. As expected, defecting led to a significant blush response in the defecting participant. However, the perceived intensity of the blush response was not significantly associated with the interdependent other's actual choice behaviour on the 'post-being cheated' trial. Meanwhile,

¹ In a PDG, participants play several rounds of decision making (cooperate or defect) with an opponent. Participants make their decision without knowing the opponent's decision and money can be earned in each round. Payout depends upon the participant's decision and that of the opponent. Normally, when both cooperate the division of money is equal. When one person defects whereas the other cooperates, the defector earns more than is received in the case of a joint cooperation; the cooperator earns little or nothing. When both participants defect they both earn little, but usually more than the cooperator in the case of one participant cooperating and the other participant defecting. In a morally framed PDG the cooperation option is primed as the moral option.

there was a meaningful relationship between the perceived intensity of the cheater's blush and the observer's judgment. Yet, the intensity of the blush response was not associated with a more favourable judgment of the blushing 'cheater'. In contrast, results indicated that the more the defector blushed, the less positively she was judged by the interdependent other. One explanation for this could be that the present context was ambiguous with respect to the defector's motive. The opponent's defecting could reflect innocent playing around (e.g., to prevent the experiment from getting boring), but also an intentional – and thus unfair – act to maximize outcomes for the self at the expense of the other person in the game. Also, here the observer might reason that if the defector was really innocent, then why would she blush?

We therefore carried out a subsequent PDG study in which we disambiguated the actor's behaviour in half of the participants, via informing the interdependent other that it was not the choice of the actor to defect but that she was forced to cheat as part of the experimental manipulation (Smits, 2003). Sustaining the hypothesis that the absence of a remedial effect in the earlier study might be attributed to the ambiguity of the experimental context, a positive relationship between the perceived intensity of the blush and the rated trustworthiness of the actor did emerge in the group of informed observers but not in the group of uninformed observers (Smits, 2003).

Although we were thus successful in showing that in real-time interactions displaying a blush following a transgression was associated with a more positive judgment, there were at least two shortcomings in this design (Smits, 2003). First, the behavioural measure (i.e., choice behaviour on the trial after being cheated) might have been too insensitive to detect the positive effect of the blush at the behavioural level. Second, the blush was clearly not isolated from other concomitant behaviour that might co-occur with the blush and could also have influenced observers, such as looking away or stammering. Therefore, we designed a subsequent study in an attempt to remedy both shortcomings.

In this subsequent study participants played the PDG with a virtual opponent via the internet (Dijk *et al.*, 2011). After each round of the PDG, a photograph of the virtual opponent was shown on the screen (cf. Dijk *et al.*, 2009). During the PDG, the virtual opponent always defected in the second round. Following defection, the opponent displayed a neutral face, a neutral face with a blush, an embarrassed face, or an embarrassed face with a blush. Thus, in half of the cases the cheating opponents blushed afterwards. To test if blushing affects the observers' tendencies to (not) trust or forgive the opponent after this defection, participants' trust-related behaviour was measured in a subsequent trust

task, which we hoped would be more sensitive than the original categorical measure (cooperation or defection). In a trust task, participants decided how much money (0–10 euros) they wanted to give to the virtual opponent. They were further informed that the amount of money that the opponent received would be tripled, and that the opponent could return to the participant any amount of the money that she had just earned. The amount of money a participant gives to the opponent can be seen as an index of how much he/she trusts the opponent (to give a fair amount of money back). Thus, this study employed a more sensitive (quantitative) behavioural index of sustained trust and used a virtual instead of a real interaction to allow tight experimental control of the facial expression of the opponent (blush or no blush), while also controlling for possible concomitant behaviours that might influence observers' judgments.

The results of this study supported further the alleged remedial function of blushing; blushing systematically improved judgments of the transgressing opponent. Most importantly, the findings indicated that the remedial effects were also evident in the observer's behaviour. Blushing positively affected trust-related behaviour towards the defector in an interpersonal context. When the virtual opponent blushed after she defected she was entrusted with more money in the subsequent trust task than when she did not blush. This sustains the view that blushing can function as a signal that recuperates trustworthiness after a social transgression.

The study also provided some results that may help explain how the blush succeeded in influencing the observer's behaviour. First, the study showed that blushing positively affected the expectations of the opponent's future behaviour. By showing a blush the opponent appeared to show that, although she cannot present herself as irreproachable on this occasion, she is at least disturbed by the transgression and may be cooperative at some other time (cf. Goffman, 1967). Second, participants' responses showed that they believed that the blushing opponent was more worried about the other's judgment than the non-blushing opponent. Finally, blushing led to the impression that the opponent sincerely regretted the defection and was not just pretending to regret the defection. Clearly, it requires further research to test whether the influence of the blush on the interdependent other indeed critically depends on modifying these types of judgments.

Of course the PDG represents a highly specific interpersonal context and it remains important to test the influence of the blush also in other social situations. Germane to this, Xueni Pan (2009) used a completely different approach to circumvent the inherent difficulty of studying the

influence of the blush in real-time interactions. In her study, she manipulated the absence/presence of a blush in a virtual character (avatar) and tested the impact of avatar blushing on real persons' behavioural responses. She instructed participants that some information would be presented about the 2008 Olympic Games by an avatar who would present a video. However, this video repeatedly failed to load. The avatar then apologized and the participant was invited to try again to start the video. In one condition the avatar never blushed whereas in the critical condition the avatar showed a reddening of the cheeks. A similar 'error message' could occur a maximum of ten times. This design thus allowed testing of whether participants' willingness to (again) restart the programme would be affected by the blush of the avatar. Interestingly, the proportion of participants who continued to the end (ten restarts) was greatly affected by the absence/presence of a blush on the avatar's cheeks. More than half of the participants in the non-blushing condition appeared willing to restart ten times, whereas only a small minority (18 per cent) of the participants in the cheek-blush condition reached the final trial. Thus, participants tended to withdraw earlier and were less tolerant if the avatar was blushing following the failure of the video to load.

Thus, during interactions with a virtual character the blush affected the behaviour of the observer. Yet, in this context it did clearly not have a positive, desirable effect. One explanation for this might be that people may usually consider a computer failure as a random error that may be solved by restarting, and for which no one in particular can be blamed or held responsible. However, by displaying the blush, the avatar may have prompted observers to hold the avatar responsible for the failure to get the video loaded. One or two times displaying a blush after a failure to start up properly may then be acceptable, but at some stage it would require more than an apology. Participants may start 'thinking' along the lines that it would be preferable for the avatar to do a proper job instead of making another apology. Future research is needed to arrive at more solid conclusions in this respect.

Conclusions and future research

The available evidence clearly corroborates the view that blushing has relevant signal value in interpersonal situations. Moreover, it has been found that blushing also has unique signal value over and above other signs of shame or embarrassment before others. Both the signal value and the social implications of the blush have been shown to be highly context-dependent. In situations that clearly imply some kind of misbehaviour such as a faux pas or an obvious transgression, the blush

showed face-saving properties and seems to serve as a nonverbal submissive excuse. Yet, in many other situations that are more ambiguous with regard to the blushing actors' antecedent behaviours and/or their underlying intentions, the blush may have undesirable revealing effects.

There are also some preliminary findings that may help explain how the blush succeeds in affecting the observer's appreciation of the actor. Most importantly, the internet PDG study (Dijk *et al.*, 2011) showed that participants believed that the blushing opponent was more worried about the other's judgment than the non-blushing opponent was. In addition, the findings indicated that blushing led to the impression that the opponent sincerely regretted the defection and was not just pretending to regret the defection. Together, these findings sustain the view that the blush may have a special role within the submissive and placatory behavioural signalling system, as a valid signal of sincere concern about others' judgments.

To the extent that indeed the blush has unique signalling properties, one may wonder what the impact of skin complexion is on the efficacy of this signalling device. There is clear evidence from both self-reports (Simon & Shields, 1996) and physiological studies that the physiological blush response is independent of people's skin colour (Drummond & Lim, 2000). However, the visibility of the blush response seems nevertheless to vary as a function of people's skin complexion. It would therefore be interesting to actually test whether skin complexion is a critical factor here and whether people whose blushing cannot be accurately detected may have acquired other displays and/or strategies to signal the blush-contingent mental state. Germane to this, previous experimental research showed that after a clear-cut predicament, participants typically engaged in (alternative) self-presentational tactics to improve their damaged social image when they were led to believe that the experimenter *did not* notice their blushing (on a bogus apparatus) (Leary *et al.*, 1996). It would be interesting to see whether this represents a more general tactic that people also use in other contexts (e.g., following a moral transgression) and most of all whether the strength of such motivated expression of embarrassment and/or shame may also vary as a function of temporary (e.g., ambient light) or relatively stable (e.g., skin complexion) differences in the visibility of one's blushing.

Although in the studies reported in this chapter blushing was found to influence the behaviour as well as the judgments of the observing participants, during the post-experimental debriefings it became evident that these participants were often completely unaware of the fact that blushing was somehow involved in the studies (e.g., Dijk *et al.*, 2009;

Dijk *et al.*, 2011). This is consistent with the view that the signal value of the blush may operate quickly and at an implicit level (cf. Willis & Todorov, 2006; Glashouwer *et al.*, 2011). Knowing the neural basis of perceiving a blush might help in understanding the mechanisms involved in this complex interpersonal response. It has been shown that specific brain networks are involved in the implicit judgment of faces in terms of trustworthiness (e.g., Winston *et al.*, 2002; Singer *et al.*, 2004). It would be interesting to see whether similar brain patterns are evident when participants observe blushing actors. Furthermore, by comparing the neural response to shame (without a blush) with the response to a blushing person we might be able to test the hypothesis that blushing, in particular, elicits neural responses that are associated with trustworthiness. This would also be relevant for the question whether or not blushing signals something that otherwise could not be signalled in these contexts: namely, that one is sincerely ashamed or embarrassed before others and willing to take a subordinate position.

People do blush in many types of situations and the research discussed in this chapter clearly shows that the effect of blushing is context-dependent (e.g., de Jong *et al.*, 2003). The situations that have been tested thus far are nevertheless restricted to (apparent) mishaps and (apparent) transgressions of social/moral rules. In all of these situations a (nonverbal) apology from the actor may be expected. It would be interesting for future research to examine the signal value and social implications of the blush in social situations that seem not to require the actor's (nonverbal) excuse. For example, how would the blush affect the observer's judgment when the actor displays a blush while being the centre of attention or during the exposure of something personal, or in common situations in which people usually do not blush (cf. Dijk *et al.*, 2010)? Do people obtain a more favourable or less favourable judgment when they blush in these types of situations? And to the extent that the blush does influence the observer's judgment of the actor, what would be the most relevant dimensions? One could speculate that someone who blushes during the exposure of a secret might be considered to be weak or socially incompetent but might nevertheless be the preferred choice for a game that requires mutual cooperation because he or she might be considered easier to 'read' (Boone & Buck, 2003). Thus, a short-term effect of obtaining a negative judgment does not imply that the blush has no desirable consequences, since in the long run there can be an advantage in being known to be a blusher (Frank, 1988). Thus, besides examining the immediate interpersonal effects of blushing, it might be fruitful to examine the long-term interpersonal effects of the blush as well.

Finally, it might be relevant to extend the research on the social implications of the blush to the more general impact of phasic changes of people's skin colour on interpersonal behaviours. Since the human visual system seems equipped with an exceptional sensitivity to two dimensions of skin reflectance modulation – one associated with haemoglobin oxygen saturation and one associated with haemoglobin skin concentration – this seems to provide the opportunity to detect both the level of blood accumulation in the skin (e.g., because of blood pooling or increased circulation) and the type of blood (venous or arterial). So it would be interesting to see whether perhaps more subtle changes in skin colour may more generally affect interpersonal behaviours. In this respect it might be especially relevant to differentiate between the impact of the more reddish colour of arterial blood – which may be associated with a more dominant, aggressive mental state – and the impact of the more greenish colour of venous blood, which seems most relevant for social blushing. Moreover, it might be that the impact of the blush also depends on the level of blood accumulation. In some contexts, a subtle, mild reddening might have a positive influence, whereas under the same conditions a strong coloration might have detrimental social consequences. The same might be true for the social implications of other types of blood-related reddening of visible body parts, such as the blush that sometimes occurs in more prolonged social evaluative contexts and that seems to creep on your skin, especially around the neck. The (implicit) impact of such state-dependent facial coloration in interpersonal interactions might even open a completely new avenue of research on the (implicit) impact of signalling one's more subtle emotional and/or motivational states in interpersonal contexts.

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