

# The Regulatory Function of Self-Conscious Emotion: Insights From Patients With Orbitofrontal Damage

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Although once considered disruptive, self-conscious emotions are now theorized to be fundamentally involved in the regulation of social behavior. The present study examined the social regulation function of self-conscious emotions by comparing healthy participants with a neuropsychological population—patients with orbitofrontal lesions—characterized by selective regulatory deficits. Orbitofrontal patients and healthy controls participated in a series of tasks designed to assess their social regulation and self-conscious emotions. Another task assessed the ability to infer others' emotional states, an appraisal process involved in self-conscious emotion. Consistent with the theory that self-conscious emotions are important for regulating social behavior, the findings show that deficient behavioral regulation is associated with inappropriate self-conscious emotions that reinforce maladaptive behavior. Additionally, deficient behavioral regulation is associated with impairments in interpreting the self-conscious emotions of others.

Embarrassment is not an irrational impulse breaking through socially prescribed behavior but part of this orderly behavior itself. (Goffman, 1956, pp. 270–271)

Psychologists have long assumed that social behavior is the product of countervailing forces. People are motivated to act on impulse and inclination but simultaneously regulate their social behavior according to social norms and moral strictures. Early theorists directed their attention to the conflict between inner impulse and external constraint. In more contemporary psychology, this conflict plays out within the workings of the individual. For example, individuals must manage the tension between approach and inhibition tendencies (e.g., Carver & Scheier, 1990; Depue, 1995; Gray, 1982; Vohs & Heatherton, 2000).

Within the field of emotion, self-conscious emotions are theorized to have evolved for the purpose of regulating approach and inhibition tendencies that could threaten social relations (Baumeister, Stillwell, & Heatherton, 1994; Ferguson, Stegge, & Damahuis, 1991; Gilbert, Pehl, & Allan, 1994; Keltner & Buswell, 1997; Miller & Leary, 1992; Niedenthal, Tangney, & Gavanski, 1994; Tangney, Miller, Flicker, & Barlow, 1996; Wicker, Payne, & Morgan, 1983). However, empirical support for this theory has proven elusive because of methodological challenges.

The present study provides a more direct test of the regulatory function of self-conscious emotions using a neuropsychology ap-

proach. A neurological population with selective deficits in the regulation of social behavior was compared with healthy control participants. This approach was used to examine the extent to which variation in self-regulation deficits relate to self-conscious emotion. If self-conscious emotions are associated with the regulation of social behavior, then individuals who consistently violate the norms governing social behavior should show deficits in their self-conscious emotions. Additionally, they should be deficient in appraisal processes involved in self-conscious emotions such as interpreting others' emotions.

## Self-Conscious Emotions and the Regulation of Social Behavior

Self-conscious emotions include embarrassment, shame, guilt, and pride. These emotions involve complex appraisals of how one's behavior has been evaluated by the self and other people. Therefore, self-conscious emotions require the ability to evaluate one's self and to infer the mental states of others. Given their cognitive complexity, self-conscious emotions emerge later in development than emotions like anger and fear (Lewis, 1993).

Self-conscious emotions were often considered disruptive to social interaction by early theorists (for a review, see Keltner & Buswell, 1997). More recent conceptualizations have focused on how self-conscious emotions regulate social behavior in ways that promote social harmony. Four lines of research have been used to support claims about the regulatory function of self-conscious emotion.

First, narrative research has shown that the self-conscious emotions arise in relation to the appropriateness of social behavior (Edelmann, 1987, 1990; Keltner, 1995; Keltner & Buswell, 1997; Lewis, 1993; Miller, 1992, 1996; Miller & Leary, 1992; Miller & Tangney, 1994; Parrott & Smith, 1991; Tangney, 1990, 1991, 1992; Tangney & Fischer, 1995). For example, individuals have consistently reported feeling embarrassed after violating social conventions. These social conventions may include norms that regulate intimacy, demeanor, poise, and exchanges between

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strangers in public interactions (Keltner & Buswell, 1997; Miller, 1992; Tangney et al., 1996). For example, Miller (1996) reported the story of an individual who became embarrassed after sharing his unedited thoughts about an actress' performance with a stranger only to find out that the actress was the stranger's wife. Consistent with the theory that self-conscious emotions regulate adaptive social behavior, many of these feelings arise in relation to inappropriate social behavior.

Second, the rewarding experience of pride and the punishing experience of embarrassment, guilt, and shame may reinforce appropriate social behavior. For example, people will sacrifice financial gain to avoid engaging in an embarrassing act (Brown, 1970). The experience of pride, in contrast, may signal socially appropriate behavior to be repeated. Therefore, the self-conscious emotions may act as internal rewards and punishments, deterring socially inappropriate behavior and rewarding socially appropriate actions.

Third, the expression of some self-conscious emotions repairs social relations following transgressions. Embarrassment and shame have distinct nonverbal signals that resemble appeasement gestures in other species (e.g., Edelman, 1987; Keltner, 1995; Keltner & Buswell, 1997). These displays of self-conscious emotion prompt others to forgive the transgressor (e.g., Keltner & Anderson, 2000; Miller, 1995; Robinson, Smith-Lovin, & Tsoudis, 1994; Salekin, Ogloff, McFarland, & Rogers, 1995). For example, in one study people expressed more positive attitudes toward an individual who had knocked over a supermarket display when that individual showed visible embarrassment than when he reacted in neutral fashion (Semin & Manstead, 1982). Self-conscious emotions not only constrain inappropriate behavior, their very expression makes amends for actual transgressions.

Finally, people prone to poor behavioral regulation show deficits in self-conscious emotion. For example, the emotions of adolescent boys who were characterized by their teachers as prone to aggression and delinquent behavior (i.e., *externalizers*) were compared across a series of tasks with the emotions of boys not characterized as externalizers (Keltner, Moffitt, & Stouthamer-Loeber, 1995). Externalizers expressed less embarrassment and more anger in comparison with the control boys while participating in an interactive IQ test. These findings imply that self-conscious emotions tend to be reduced in populations that have difficulty regulating their behavior.

#### Studying the Regulatory Function of Self-Conscious Emotion With Neuroscientific Methods

The evidence reviewed thus far has led theorists to assert that the self-conscious emotions' primary function is to motivate socially appropriate behavior by alerting individuals to which behaviors are rewarded and punished in particular social interactions. However, the studies that have led to this assertion have provided little direct evidence for this claim. Most studies have been descriptive in nature, characterizing the elicitors, experience, and display of self-conscious emotion. Few studies have related self-conscious emotion to the regulation of social behavior.

What sort of evidence would be relevant to claims about the regulatory function of self-conscious emotion? The strongest approach would be to relate systematic variation in the self-conscious emotions to variation in the regulation of social behavior. Unfor-

tunately, variation in the kinds of social behavior that self-conscious emotions inhibit—*faux pas*, inappropriate disclosures, violations of character, immoral acts—are unlikely to occur in the laboratory and are fairly difficult to capture with observational methods. Individuals are socialized from a very early age to regulate their behavior. Just as walking and talking begin as effortful processes and eventually become automatic, behavioral regulation becomes a well-learned process. As a well-learned process, regulation of social behavior is difficult to override in experimental or naturalistic studies.

Furthermore, although the use of psychiatric populations has been helpful in creating variance in behavioral regulation, these types of studies do not clearly isolate the relation between poor behavioral regulation and impaired self-conscious emotion. Extensive developmental differences may differentiate psychiatric and control populations. Additionally, the behavioral and emotional deficits associated with psychiatric syndromes are often much broader than poor social regulation and disrupted self-conscious emotion. Therefore, the question remains: How can the association between self-conscious emotion and regulated social behavior be studied?

Neuroscientific methods suggest another avenue for examining the regulatory function of self-conscious emotion. Neuroscientists traditionally have examined the mechanisms underlying overlearned abilities by studying neuropsychological populations. A proxy manipulation of overlearned abilities is made possible by comparing healthy participants with populations that have selective deficits (see Klein & Kihlstrom, 1998). For example, variation in the use of long-term memory is not extensive in normal populations, thus making it difficult to understand the mechanisms underlying long-term memory. However, studies of amnesic patients revolutionized conceptions of long-term memory by showing that long-term memory was not a unitary construct. Rather, it consists of episodic memory and semantic memory that are not necessarily dependent on one another.

Neuropsychological populations with focal lesions make it easier to isolate the mechanisms underlying a particular ability, because they lack the brain tissue necessary for making specific kinds of neural computations. Therefore, research on the regulatory role of self-conscious emotion may benefit from studies of self-conscious emotions in a neuropsychological population characterized by poor regulation of social behavior.

#### Orbitofrontal Brain Damage: A Model for Studying Poor Regulation of Social Behavior

The frontal lobes have been characterized as centers of regulation or executive control. The orbitofrontal region of the frontal lobes, which rests behind and above the eye orbits (i.e., Brodmann's Areas 11, 12, 14, and 47), seems particularly involved in the regulation of social behavior. The orbitofrontal cortex is richly connected to areas associated with emotional and social processing, including the amygdala, anterior cingulate, and somatosensory Areas I and II (e.g., Adolphs, 1999; Brothers, 1996). Damage to the orbitofrontal region of the frontal lobes does not impair language, memory, or sensory processing, but it does disrupt social regulation.

Both clinical characterizations and anecdotal evidence suggest that orbitofrontal damage impairs the ability to regulate social

behavior. Perhaps the most famous case study of orbitofrontal damage is Phineas Gage (e.g., Harlow, 1848). Harlow's (1848) description of Gage following his injury is filled with references to poor regulation of social behavior. For example, Harlow noted that Gage's "equilibrium . . . between his intellectual capacities and animal propensities seems to have been destroyed. He is . . . impatient of restraint or advice when it conflicts with his desires" (p. 389). Contemporary descriptions of orbitofrontal damage are consistent with difficulties in regulating behavior, particularly in discriminating which social behaviors are appropriate for interactions with strangers in comparison with those appropriate for well-known others. For example, orbitofrontal patients have been observed to greet strangers by kissing them on the cheek and hugging them (e.g., Rolls, Hornak, Wade, & McGrath, 1994), engage in uncontrolled and tasteless social behavior such as inappropriate joking (Stuss & Benson, 1984), and disclose to a stranger in inappropriately intimate fashion (Beer, 2002). It is important to note that these regulatory deficits in the social domain are not associated with damage to other areas of the brain associated with regulatory function. In comparison with other brain areas, damage to the orbitofrontal cortex selectively impairs the regulation of social behavior and therefore provides a model for understanding the mechanisms underlying this process.

Currently, the mechanisms underlying the poor social regulation associated with orbitofrontal damage are not well understood. Some theorists have attributed orbitofrontal patients' poor social behavior to impaired self-evaluation (e.g., Stuss & Benson, 1984). Orbitofrontal patients tend to be unaware that their social behavior is inappropriate in comparison with patients with dorsolateral prefrontal damage and healthy control participants (Beer, 2002). After participating in a self-disclosure task with a stranger (Aron, Melinat, Aron, Vallone, & Bator, 1997), orbitofrontal patients tended to overestimate the appropriateness of the intimacy of their self-disclosure.

The poorly regulated social behavior associated with orbitofrontal damage has also been attributed to difficulties in inferring others' mental states (Blair & Cipolotti, 2000; Stone, Baron-Cohen, & Knight, 1998). In comparison with healthy controls and dorsolateral prefrontal patients, orbitofrontal patients performed poorly when asked to identify the intentions behind social faux pas described in written vignettes (Stone et al., 1998). Consistent with these findings, one case study found impairments in the ability to identify story protagonists' feelings in situations that would typically evoke either anger, fear, or embarrassment (Blair & Cipolotti, 2000). Similarly, orbitofrontal patients have difficulty identifying emotional facial expressions in comparison with healthy controls and patients with brain damage outside the orbitofrontal cortex (Blair & Cipolotti, 2000; Hornak, Rolls, & Wade, 1996).

Still other theorists have attributed orbitofrontal patients' poor social behavior to an inability to use emotional information to guide behavior (e.g., Bechara, Damasio, & Damasio, 2000). In one well-known paradigm, participants are asked to draw cards from four decks, which result in wins or losses. Two of the decks are good choices for the participants; payoffs are low but losses are even lower. Two of the decks are bad choices for the participants; payoffs are high but losses are even higher. In comparison with control participants and patients with dorsolateral prefrontal lesions, orbitofrontal patients do not significantly differ in their galvanic skin response to wins or losses after they have drawn a

card. However, unlike control participants and patients with dorsolateral lesions, orbitofrontal patients do not show an increase in galvanic skin response when drawing from one of the decks that has been shown to be a bad choice. In other words, orbitofrontal patients do not seem to be able to connect the positive or negative consequences of past experiences with future behavioral choices.

Finally, a failure to filter out irrelevant information has been proposed to account for the social deficits associated with orbitofrontal damage (e.g., Rule, Shimamura, & Knight, 2002; Shimamura, 2000). Rule et al. (2002) presented patients with orbitofrontal lesions and control subjects with mildly aversive shocks and sounds while they were watching a silent movie. Compared with control subjects, orbitofrontal patients exhibited larger event-related potentials to both the tactile and auditory stimuli and showed lower levels of habituation across blocks of stimuli. These findings suggest that orbitofrontal patients fail to inhibit responses to irrelevant information.

These four accounts, of course, are not mutually exclusive. Orbitofrontal patients may be poor at regulating their social behavior because their self-conscious emotion system is impaired. Self-conscious emotions rely on all of the mechanisms proposed to account for the poor social regulation associated with orbitofrontal damage: the ability to evaluate one's self, the accurate perception of others' evaluations (i.e., mental states), and the synthesis of relevant emotional experience with behavioral choices. Therefore, the present research does not pit one or more of the proposed mechanisms against one another. Rather the present research brings together elements of all of these explanations to understand the relation between poor social regulation and the regulatory function of self-conscious emotions. If orbitofrontal patients lack self-awareness and are unable to infer other people's evaluations, they may fail to evaluate whether their behavior conforms to social standards held by themselves or other people. In the absence of self-conscious emotion, these patients may simply be unmotivated to modify inappropriate behavior, and therefore they engage in chronically inappropriate behavior.

## Overview of the Present Study

Studies have suggested that orbitofrontal cortex damage selectively impairs the regulation of social behavior and therefore provides a good model for understanding the mechanisms underlying this regulation process. On the basis of this assumption, the present study compared patients with lesions of the orbitofrontal cortex and healthy controls in a series of tasks designed to test whether variation in the self-conscious emotion system is related to variation in the regulation of social behavior.

First, two tasks were included to test whether orbitofrontal patients and control participants differed in their regulation of social behavior. The present study assessed self-disclosure and teasing behavior, two examples of behavior that must be regulated when interacting with strangers. In other words, the appropriate execution of teasing or self-disclosing requires situational modifications taking into consideration the specific persons and context involved (e.g., Cozby, 1973; Keltner, Capps, Kring, Young, & Heerey, 2001). Consistent with clinical characterizations of orbitofrontal damage, it is hypothesized that orbitofrontal patients will violate norms of familiarity significantly more than control participants. In particular, orbitofrontal patients should self-disclose in

an inappropriately intimate fashion and tease in more familiar ways than control participants.

Second, the present study compared the emotional experiences of orbitofrontal patients and control participants (i.e., two populations that differ in the appropriate regulation of their interpersonal behavior). More specifically, emotional experiences were assessed in response to two interpersonal contexts: teasing and overpraise. If self-conscious emotions are necessary for regulating social behavior, then orbitofrontal patients should be selectively deficient in their self-conscious emotions when compared with control participants.

There are two possibilities for the selective deficiencies of the self-conscious emotions of orbitofrontal patients. It may be that orbitofrontal damage impairs the ability to generate self-conscious emotions in the first place. In this case, orbitofrontal patients may experience significantly less self-conscious emotion but not differ in other kinds of emotion than control participants. Alternatively, orbitofrontal damage has been associated with an overestimation of the appropriateness of one's social behavior (Beer, 2002). Therefore, it may be that orbitofrontal damage impairs the generation of the appropriate self-conscious emotion in response to one's inappropriate behavior. From this perspective, orbitofrontal patients may feel particularly proud of their behavior even when they have violated social norms in comparison with control participants. Similarly, orbitofrontal patients may become embarrassed in humble gratitude when praised for their creativity even though the praise is undeserved. In other words, orbitofrontal patients may believe that the praise is deserved but become embarrassed when put in the awkward position of having to react to such glowing comments. In contrast, healthy participants may correctly perceive that it was impossible that their behavior could deserve such praise and become amused by the strange behavior on the part of the person giving the compliment. It is important to note that the self-perception bias perspective does not predict a general increase in self-conscious emotion but a disconnect between the generation of self-conscious emotion and actual behavior. For example, if orbitofrontal patients are overestimating the appropriateness of their behavior, then they should not significantly differ in their embarrassment from control participants, even when the two groups have objectively differed in the appropriateness of their behavior.

Third, the present study compared orbitofrontal patients' and control participants' performance on a cognitive task fundamental in the generation of self-conscious emotion, that is, the ability to infer others' evaluations of one's self. Feedback from others in social situations is often communicated nonverbally through facial expressions of emotions (Keltner & Kring, 1998). Therefore, the present study examined the ability to identify facial expressions of various kinds of emotion. If the ability to infer others' evaluations of one's behavior is necessary for appropriately experiencing self-conscious emotions, then orbitofrontal patients should be significantly worse than control participants at recognizing the emotional expressions of others.

## Method

### Participants

Participants consisted of 5 neurological patients with orbitofrontal lesions and 5 healthy control participants matched on the basis of age,

gender, level of education, and community of residence. The patients and 2 of the control subjects had previously participated in research studies; none had previously participated in any type of study involving social interaction paradigms. The orbitofrontal patients were all male, 52 years old on average ( $SD = 9$ ), and mostly Caucasian (1 Hispanic). Control participants were all male, 56 years old on average ( $SD = 10$ ), and mostly Caucasian (1 African American). All patients had longstanding focal, bilateral damage to the orbitofrontal cortex as the result of traumatic accidents during adulthood. Consistent with studies of other orbitofrontal patients, neuropsychological tests showed that these particular patients were not impaired in memory or language functions (e.g., Beer, 2002; Shimamura, 2002).

This patient sample provided a strong test of the present hypotheses for two reasons. First, the sample size used in the present study ensured a reasonable level of power for the planned analyses. Second, lesion homogeneity across patients is fundamental for valid tests of the functional relation between a specific brain area and hypothesized effects. In the present research, the patients' lesions were similar in location and volume (see Figure 1), allowing for a clear test of the relation between orbitofrontal cortex lesions and social behavior.

### Self-Disclosure Task

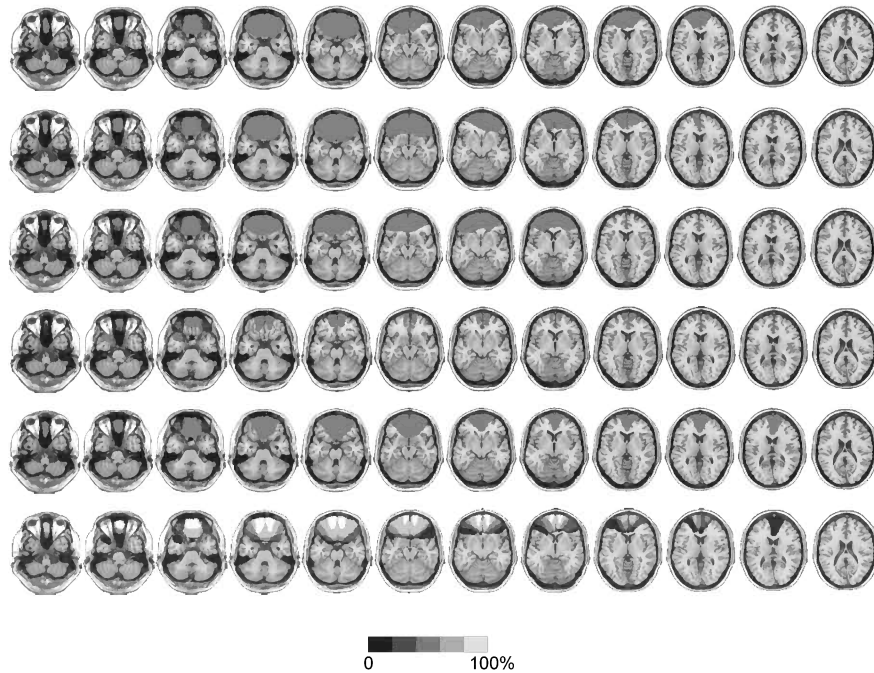
**Task.** In a face-to-face interview with experimenters, participants were presented with a set of emotional terms and asked to define each term and give an example of a time they had felt that way. The emotional terms included non-self-conscious emotions (i.e., *anger, disgust, fear, sadness, happiness, contempt, surprise, disappointment, and curiosity*) and self-conscious emotions (i.e., *embarrassment, guilt, shame, pride, and self-conscious*).

**Regulation of social behavior: Self-disclosure coding.** Two judges, blind to hypotheses and participant status, coded participants' responses for the intimacy of their self-disclosure when providing examples of times they had felt a particular emotion. Self-disclosure ratings were made using a scale ranging from 1 (*Not at all*) to 7 (*Very much so*). Ratings were averaged across all of the 14 emotion terms to create an overall index of self-disclosure intimacy ( $\alpha = .84$ ).

### Teasing Task

**Task.** Participants were told that this part of the experiment involved a nickname game. Participants were instructed to make up a nickname for each of two experimenters who were unfamiliar to them and explain the meaning of the nickname. Each of the experimenters assigned herself a set of randomly generated initials (i.e., "A. D.," "L. I.," see Keltner, Young, Heerey, Oemig, & Monarch, 1998). Participants were told that any nickname was acceptable, but if it was helpful they could use the initials as a guide for the nickname. Participants were given as much time as they needed to generate the nicknames, and most completed the task within a few minutes.

**Regulation of social behavior: Behavioral coding of teasing behavior.** Two trained judges coded videotaped teasing interactions for the appropriateness and inappropriateness of the participants' teasing behavior. Operationalizations of appropriate and inappropriate teasing were derived from the literature on teasing, which suggests that teasing between strangers must be qualified much more than teasing with close others in order to have a positive social effect (Keltner et al., 2001). Therefore, appropriate teasing behavior was operationalized as the frequency of apologetic teasing behavior. Examples of appropriate teasing behavior included verbal apologies, submissive body posture, and blushing. Inappropriate teasing behavior was operationalized as the frequency of hostile and overly familiar teasing behaviors. Examples of inappropriate teasing included excessively sustained eye contact, intrusive body posture, and playful gestures and prosody. Agreement between the judges was high for both appropriate ( $r = .98$ ) and inappropriate ( $r = .97$ ) teasing behavior.



*Figure 1.* Lesion reconstructions for the patients in the present study. To reconstruct lesions, 212 isovolumetric continuous coronal slices, 5.0 mm thick, were initially obtained on a 1.5 Tesla superconductive scanner (Picker International, Highland Heights, OH). Lesions were then transcribed from scans onto sequential axial templates. The first five rows in the figure portray an individual patient's lesion across continuous slices. The bottom row portrays overlap for each slice across the sample. The dark-to-light (0%–100%) bar represents the percentage lesion overlap in the group for specific areas within the orbitofrontal cortex.

*Self-reported emotion.* After completing the nickname game, participants reported how they felt about their performance while teasing the experimenters. Participants reported how much amusement, embarrassment, and pride they felt, using a scale ranging from 1 (*Not at all*) to 5 (*Extremely*). Self-report was used to measure emotion in this task because no facial expression of pride has been established, and it was of interest in this particular task.

### Overpraise Task

*Task.* Participants were read a passage on the purpose of formal education and asked to generate a title for the passage. After each participant had stated a title, the two experimenters overpraised the participant by exclaiming that the title was the most creative and superior they had heard. The overpraise period consisted of 2–3 min of effusive praise.

*Emotional expression.* An unobtrusive measure of emotion was necessary for the overpraise task so that the participants would not suspect that the point of the task was to elicit emotion. Therefore, participants' facial expressions from the overpraise period were coded using the Facial Action Coding System (Ekman & Friesen, 1976, 1978). Videotaped recordings of each participant were reviewed and facial muscle movement identified. The frequency of muscle movements conforming to prototypical displays of embarrassment (Keltner, 1995) and to amusement (Frank & Ekman, 1993) was used to measure expressions of embarrassment and amusement, respectively. Reliability between the coders was calculated by subtracting the number of uniquely coded muscle movements (i.e., only identified by

one coder) from the consensus-coded muscle movements (i.e., identified by both coders) and divided by the sum total number of muscle movements identified by both coders (e.g., Keltner & Bonanno, 1997). Coder reliability was .73.

### Perception of Feedback: Emotional Facial Expressions

*Task.* Participants were presented with a series of pictures of emotional expressions and instructed to identify the depicted emotional expression. The 10 pictures were presented 1 at a time, in random order. The facial expressions consisted of various emotional expressions, including non-self-conscious emotions (i.e., 1 photo each of anger, disgust, fear, happiness, sadness, contempt, surprise, and amusement) and self-conscious emotions (i.e., 1 photo each of embarrassment and shame; Haidt & Keltner, 1999). To avoid problems associated with forced-choice methods in emotion judgment studies (see Haidt & Keltner, 1999; Russell, 1994), a partly free-response method was used. Participants were instructed to generate an emotion word that best described the photo. They were told that they could generate their own word or use one from a general list of emotion terms provided by the experimenter (*anger, amusement, contempt, disgust, embarrassment, fear, happiness, neutral, sadness, shame, and surprise*). Therefore, participants had the option to rely on the emotion-word list as they chose but were not constrained by the limitations of a forced-choice design.

*Inferring others' emotional states: Emotion perception coding.* Responses to the photos were classified as either correct or incorrect. If a

participant labeled a photo using the correct word from the emotion-word list—for example, labeling a photo depicting anger with the words *anger* or *angry*—the response was considered correct. However, 22% of participants' responses (16 distinct words) did not appear on the emotion-word list (e.g., *frustrated*, *distracted*, *flabbergasted*, *stoned*, etc.). To determine whether the response was correct, expert judges (i.e., graduate students in emotion) classified participants' responses into 10 emotion categories represented by the emotion words presented to the participants. A participant's response was considered correct if the judges' classification of the response matched the actual emotion depicted by the photo. Kappa coefficients ranged from .78 to .97.

## Results

### Regulation of Social Behavior: Self-Disclosure of Past Emotional Experiences

Consistent with clinical characterizations, orbitofrontal patients failed to regulate their behavior. Orbitofrontal patients self-disclosed unnecessarily intimate information when describing their past emotional experiences in comparison with control participants,  $t(8) = 4.35, p < .05, d = 3.08$  (see Figure 2). Although the task required participants to disclose some intimate information, orbitofrontal patients' self-disclosures went beyond the intimacy required by the task. For example, orbitofrontal patients tended to include sexually intimate details when describing past emotional experiences, which were not necessary to complete the task (e.g., patient: "I felt guilty when I cheated on my wife" and "I felt embarrassed when I was discovered in a store's dressing room with my girlfriend" vs. control: "I felt guilty when I hurt my friend's feelings" and "I felt embarrassed when I didn't understand the punch line of a joke"). Patients self-disclosed in a highly intimate manner that was not necessary to complete the task and in a manner better suited for exchanges with close others than with strangers.

### Regulation of Social Behavior: Teasing Behavior

Orbitofrontal patients more frequently exhibited inappropriately intimate and hostile teasing behavior such as sustained eye contact, intrusive body posture, and playful gestures and prosody,  $t(6) = 3.15, p < .05, d = 2.57$  (see Figure 3).<sup>1</sup>

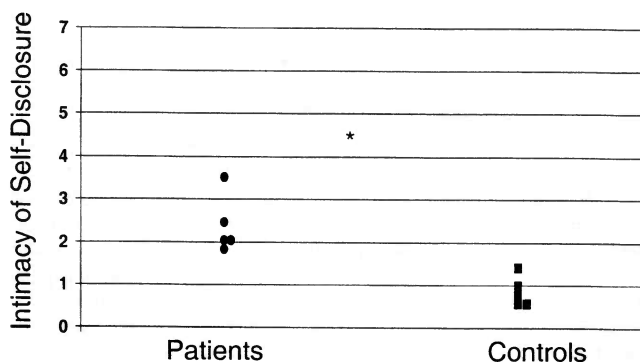


Figure 2. Intimacy of self-disclosure for orbitofrontal patients and control participants. Ovals represent patients; rectangles represent controls; asterisk represents a significant difference.

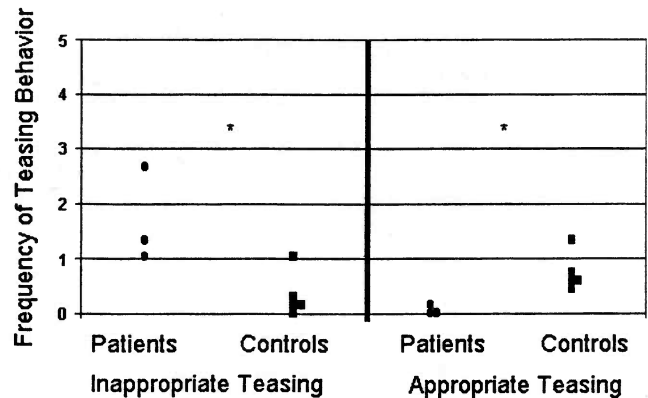


Figure 3. Frequency of inappropriate and appropriate teasing behaviors for orbitofrontal patients and control participants. Ovals represent patients; rectangles represent controls; asterisks represent significant differences.

Orbitofrontal patients less frequently exhibited appropriate, apologetic teasing behavior such as verbal apologies, submissive body posture, and blushing,  $t(6) = 3.79, p < .05, d = 3.09$  (see Figure 3). Consistent with clinical characterizations and the self-disclosure findings in the present research, the teasing findings suggest that orbitofrontal patients fail to regulate their behavior. Not only did orbitofrontal patients exhibit more inappropriate behavior during the teasing task, they also exhibited less appropriate behavior than control participants. Together, these findings suggest that orbitofrontal patients tend to tease strangers in an overly familiar manner better suited for more intimate dyadic interactions.

### Emotion: Teasing Interaction

After the teasing interaction, orbitofrontal patients reported greater feelings of pride,  $t(7) = 2.43, p < .05, d = 1.83$ , but did not significantly differ in their amusement,  $t(7) = .44, p > .05, d = .33$ , or embarrassment,  $t(7) = .64, p > .05, d = .48$ , in comparison with control participants (see Figure 4). Consistent with the hypothesis that the self-conscious emotions of orbitofrontal patients are inappropriately related to their behavior because of faulty self-perception processes, orbitofrontal patients' self-reports of emotion were similar to those of the control participants who had behaved appropriately. Similar to control participants, orbitofrontal patients found the teasing task amusing and not terribly embarrassing, even though they had behaved more inappropriately.

<sup>1</sup> The reduced degrees of freedom are accounted for by missing data for 2 patients. Equipment failure prevented the video recording of 1 patient's performance during the teasing task. Another patient refused to participate in the teasing task. Therefore, data for teasing behavior were acquired from the 3 videotaped patients (Figure 3) and data for self-reported emotion during the teasing task were acquired from the 4 patients who participated in the task (Figure 4). Accordingly, only data from the relevant matched control subjects were included in each analysis.

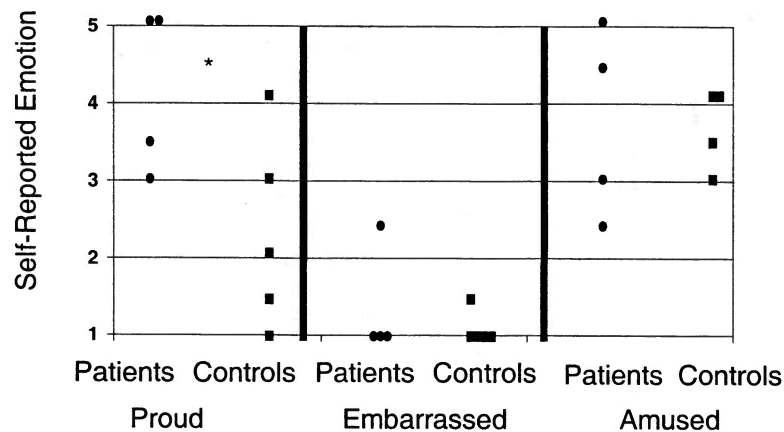


Figure 4. Self-reported pride, embarrassment, and amusement while teasing for orbitofrontal patients and control participants. Ovals represent patients; rectangles represent controls; asterisk represents a significant difference.

ately. In fact, orbitofrontal patients were more proud than control participants of their teasing behavior.<sup>2</sup>

#### Emotion and Perception of Feedback From Others: Overpraise Task

Orbitofrontal patients expressed more embarrassment than controls,  $t(8) = 2.77, p < .05, d = 1.95$ , but did not differ significantly in expressions of amusement,  $t(8) = 1.84, p > .05, d = 1.30$  (see Figure 5). Consistent with the perspective that orbitofrontal damage impairs the ability to appropriately link self-conscious emotions with behavioral performance, orbitofrontal patients become more embarrassed than control participants when there is no reason to be embarrassed in order to preserve modesty (i.e., behavior is not exemplary).

#### Perception of Feedback From Others: Emotional Facial Expression Identification

Orbitofrontal patients were significantly worse at recognizing expressions of self-conscious emotion,  $t(8) = 2.89, p < .05,$

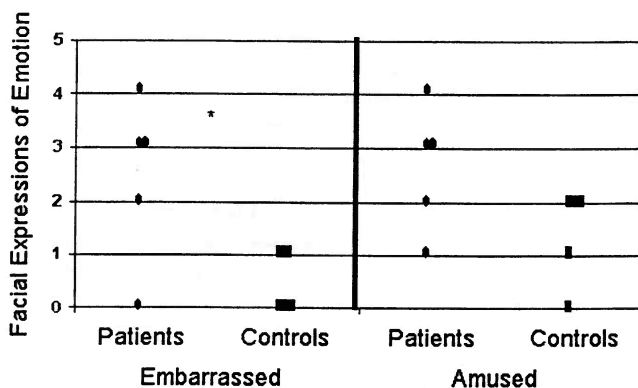


Figure 5. Coded facial expressions of embarrassment and amusement while being overpraised for orbitofrontal patients and control participants. Ovals represent patients; rectangles represent controls; asterisk represents a significant difference.

$d = 2.04$ . However, orbitofrontal patients and control participants did not significantly differ in their identification of expressions of non-self-conscious emotions,  $t(8) = .04, p > .05, d = .03$  (see Figure 6). Consistent with the hypotheses that orbitofrontal damage should be impaired in the cognitive mechanisms underlying self-conscious emotions, orbitofrontal patients were significantly worse at identifying the self-conscious emotional expressions of others.

## Discussion

Although current theories of self-conscious emotions have emphasized their role in the regulation of social behavior, methodological challenges have made it difficult to test this claim. In the present research, the comparison of patients with orbitofrontal lesions and control participants provided a model for understanding the relation between variation in behavioral regulation and self-conscious emotion. Comparisons across orbitofrontal patients and control participants provided a range of variance in behavioral regulation not found within normal populations. Therefore, it was possible to test the relation between variation in behavioral regulation and self-conscious emotion. The findings provide clear evidence supporting the role of self-conscious emotions in the regulation of social behavior.

The present research shows that the impaired behavioral regulation of the orbitofrontal patients was associated with disrupted self-conscious emotion. This was true for both self-report and coded facial expressions of emotion. Although orbitofrontal patients did generate self-conscious emotions, these emotions tended to reinforce inappropriate behavior rather than correct it. For

<sup>2</sup> The findings on pride raise the question of whether the experimenters' responses really provided enough cues for patients to understand that their nicknames were inappropriate. Clearly, it would be unethical to harshly criticize a study participant for inappropriate behavior, particularly when that behavior was hypothesized a priori. When an inappropriate nickname was generated (e.g., "Lovely and Enticing" or "After Dark"), experimenters responded with brief nervous laughter and looking down. This response indicated in a polite manner that the names were inappropriate.

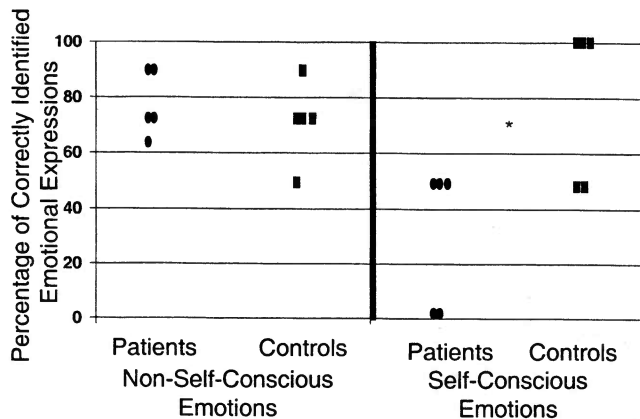


Figure 6. Recognition of emotional facial expressions for orbitofrontal patients and control participants. Ovals represent patients; rectangles represent controls; asterisk represents a significant difference.

example, orbitofrontal patients were not embarrassed by and were proud of their teasing behavior that was objectively inappropriate. Patients' experiences with embarrassment may only have reinforced their beliefs that their social behavior was exemplary. Patients' embarrassment in the praise task may have ironically left them with the impression that their behavior received such high compliments that they must be careful to show embarrassment lest others think them immodest. Ironically, the embarrassment had the opposite effect: By acknowledging the praise, albeit in a modest manner, the patients took undeserved credit for their performance. Additionally, the present research suggests that the disrupted self-conscious emotion may have been associated with impaired appraisal processes intrinsic to self-conscious emotion. A fundamental part of self-conscious emotion is the recognition of others' evaluations. These evaluations may take the form of emotional facial expressions (e.g., Keltner & Kring, 1998). In the present study, orbitofrontal patients had trouble making accurate appraisals of others' self-conscious emotions. Therefore, orbitofrontal patients may not have become embarrassed by their inappropriate behavior because they were unable to benefit from others' feedback (i.e., empathic expressions of embarrassment). Together, these findings provide unique evidence that self-conscious emotions and their underlying appraisal processes are important for the adaptive regulation of social behavior.

Future research will be important in addressing limitations of the current research. First, the current study does not tease apart whether orbitofrontal damage eliminates self-regulation of social behavior or just impairs attempts at self-regulation. In other words, it will be important to clarify whether orbitofrontal damage is associated with a general failure to regulate behavior at all or if it is better characterized by misregulation (i.e., exerting control over behavior but in an ineffective manner). Second, it will be important to examine regulatory processes and self-conscious emotions in a patient sample that has brain damage in a region other than the orbitofrontal cortex. The inclusion of patient control participants (in addition to healthy control participants) would provide a stronger test that effects are associated with damage to a particular brain region and not brain damage in general. As noted in the introduction, the social effects associated with orbitofrontal damage are not

usually found in patients with other kinds of brain damage (e.g., Bechara et al., 2000; Beer, 2002; Blair & Cipolotti, 2000; Hornak et al., 1996; Stone et al., 1998). For example, Beer (2002) also found that orbitofrontal patients were much worse at regulating the intimacy of their self-disclosure than healthy controls as well as much worse than patients with dorsolateral prefrontal cortex damage; no such differences were found between healthy controls and patients with dorsolateral prefrontal damage. The bulk of previous research has shown social deficits specifically associated with orbitofrontal damage, which suggests that the effects in the present research are specifically associated with orbitofrontal damage. However, future research is needed to test this empirically. Third, the small sample size in this study raises questions regarding the reliability of findings. Future research examining self-conscious emotion and self-regulatory processes using different experimental paradigms or a different group of orbitofrontal patients will be beneficial in strengthening the reliability of the current findings.

In general, the present research has implications for the synthesis of neuroscientific methodology with social and personality psychological theories. First, the present research is an example of another area in which neuroscientific methodology is useful for addressing questions of interest to social and personality psychologists. Extant work conducted by social and personality psychologists who have used neuroscientific methodologies have focused on associations between the amygdala and stereotyping (Phelps et al., 2000), brain laterality and attitudes (e.g., Cacioppo, Crites, & Gardner, 1996), frontal lobe activity in relation to emotional reactivity (e.g., Davidson, Ekman, Saron, Senulis, & Friesen, 1990), the structure of self-knowledge (Klein, Loftus, & Kihlstrom, 1996), and the role of memory in cognitive dissonance effects (Lieberman, Ochsner, Gilbert, & Schacter, 2001). The present study has now extended this work to the realm of self-conscious emotions and self-regulation of social behavior. This body of work has suggested that neuroscientific methodologies provide useful tools for social and personality psychologists striving for multiple methods of measurement. This is not to argue that neuroscience methodologies should be used to address any and all questions of interest to social and personality psychologists. However, previous research and the present study show that such methodologies can be useful for certain questions. In some circumstances, neuroscientific methodologies might even provide experimental manipulation that is otherwise difficult, if not impossible.

Second, the present research exemplifies that more than one kind of neuroscientific technique can be useful for addressing questions of interest to social and personality psychologists (Klein & Kihlstrom, 1998). Most of the extant research has consisted of neuroimaging studies (e.g., Cacioppo et al., 1996; Davidson et al., 1990; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001; Ochsner & Lieberman, 2001; but see Beer, 2002; Klein et al., 1996; Lieberman et al., 2001). Although neuroimaging may be used to address certain kinds of questions that are of interest to social and personality psychologists, it does not lend itself to particular behavioral paradigms. In the present study, creating variance in behavioral regulation was made possible by the inclusion of a special neuropsychological population. It would have been impossible to collect ecologically valid measures of interpersonal behavior such as teasing and self-disclosure using neuroimaging techniques. Additionally, some brain areas that are importantly involved in social and emotional processes, such as the



orbitofrontal cortex, are difficult to image using techniques such as functional magnetic resonance imaging (fMRI). Although the use of spin echo sequences and modifications of other parameters have shown promise for imaging this area (e.g., O'Doherty, Kringsbach, Rolls, Hornak, & Andrews, 2001), there is currently no reliable method for getting good coverage of the orbitofrontal cortex with fMRI. Therefore, lesion studies should not be ignored as a viable research method for psychological research.

Although a main purpose of the present research was to show how neuroscience can contribute to social and personality psychology, the present research is also an example of how psychologists can contribute to neuroscience. The present study is one of the first empirical demonstrations of the social disinhibition associated with orbitofrontal damage. Most of the evidence for the social disinhibition associated with orbitofrontal damage has consisted of clinical observations and anecdotes (Harlow, 1848; Rolls et al., 1994; Stuss & Benson, 1984; but see Beer, 2002). Although behavior is typically restrained in interactions between strangers, the present study showed that orbitofrontal patients chronically behave as if they were interacting with a close friend. In particular, orbitofrontal patients disclosed excessively personal information and used overly familiar styles of teasing when interacting with strangers.

Similarly, psychologists can contribute to neuroscience by providing overarching theories of social and personality constructs that can be related to brain function. For example, the present research has implications for understanding the mechanisms underlying the poorly regulated social behavior associated with orbitofrontal damage. The present findings suggest that the extant theories of the social functions of orbitofrontal cortex are best synthesized from the perspective of self-conscious emotions. Previously, theorists had focused either on self-awareness, on inferring the mental states of others, or on connecting emotional experiences to behavior (e.g., Bechara et al., 2000; Stone et al., 1998; Stuss & Benson, 1984). The present research suggests that all of these mechanisms are responsible for the impaired regulation of social behavior associated with orbitofrontal damage because they are all importantly involved in self-conscious emotions. In particular, it may be that orbitofrontal patients' emotional reactions are not connected to their behavior because they have difficulty appraising their behavior accurately. Orbitofrontal patients were proud of inappropriate teasing behavior and modestly accepted praise by becoming embarrassed even though it was objectively undeserved. Similarly, orbitofrontal patients may have difficulty interpreting others' reactions to their inappropriate behavior (i.e., facial expressions of empathic embarrassment) and therefore miss out on cues that might generate the self-conscious emotions needed to motivate behavior modification. Together, these findings suggest a possible way to synthesize extant theory and research on the social effects of orbitofrontal damage.

Not only can social psychologists contribute overarching theories of social and personality constructs, they can also contribute standardized tools to measure these constructs. For example, several theorists have conducted research on emotion in relation to orbitofrontal cortex functioning, yet each theorist has operationalized emotion in a different way. For example, some theorists have equated physiological arousal with emotion (e.g., Bechara et al., 2000), whereas others have quantified emotion in terms of nega-

tive or positive appraisals (e.g., Rolls et al., 1994). The lack of standardization in measurement makes it difficult to synthesize various research findings in a meaningful manner and ultimately may impede progress. Therefore, longstanding standardized operationalizations of constructs developed by social and personality psychologists will be crucial for advancing social neuroscience. In summary, greater communication between psychologists and neuroscientists will benefit both fields.

### Concluding Remarks

The present study provided support for the regulatory function of self-conscious emotions. Impaired behavioral regulation was associated with disrupted self-conscious emotion. At a broader level, the present study suggests that neuroscientific methodologies should not be ignored as tools of measurement by social and personality psychologists. A strength of the research conducted by social and personality psychologists has always been the use of multiple methods of measurement. The present study shows that neuroscientific methodologies, in particular the use of patients with focal lesions, are another useful method of measurement that may even provide experimental manipulation that is otherwise impossible.

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