



## Autonomic correlates of physical and moral disgust



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### ARTICLE INFO

#### Article history:

Received 16 November 2012

Received in revised form 6 May 2013

Accepted 7 May 2013

Available online 15 May 2013

#### Keywords:

Physical disgust

Moral disgust

Anger

Contempt

Heart rate

Heart rate variability

Disgust sensitivity

Obsessive compulsive tendencies

### ABSTRACT

Given that the hypothesis of a common origin of physical and moral disgust has received sparse empirical support, this study aimed to shed light on the subjective and autonomic signatures of these two facets of the same emotional response. Participants (20 men, 20 women) were randomly assigned to physical or moral disgust induction by the use of audio scripts while their electrocardiogram was continuously recorded. Affect ratings were obtained before and after the induction. Time and frequency domain heart rate variability (HRV) measures were obtained. After controlling for disgust sensitivity (DS-R) and obsessive-compulsive (OCI-R) tendencies, both scripts elicited disgust but whereas the physical script elicited a feeling of dirtiness, the moral script evoked more indignation and contempt. The disgust-induced subjective responses were associated with opposite patterns of autonomic reactivity: enhanced activity of the parasympathetic nervous system without concurrent changes in heart rate (HR) for physical disgust and decreased vagal tone and increased HR and autonomic imbalance for moral disgust. Results suggest that immorality relies on the same biological root of physical disgust only in subjects with obsessive compulsive tendencies. Disgust appears to be a heterogeneous response that varies based on the individuals' contamination-based appraisal.

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### 1. Introduction

Since Darwin's conceptualization, disgust has been considered a basic, universal emotion that has the adaptive function to protect the body from contact with and incorporation of harmful elements (Rozin et al., 2000). It is generally assumed that disgust is accompanied by bradycardia and increased parasympathetic responses (Levenson et al., 1992; Rozin et al., 1999a; Woody and Teachman, 2000). However, opposite results with regard to parasympathetic activity were found by van Overveld et al. (2009), Sarlo et al. (2008), and Demaree et al. (2006) who showed no significant changes in parasympathetic activity after disgust induction. Moreover, several studies showed a concurrent increase in sympathetic activation (De Jong et al., 2011; Meissner et al., 2011; Rohrman and Hopp, 2008), which is assumed to support disgust-induced avoidance and escape behaviors. In a recent review, Kreibig (2010) suggested sympathetic-parasympathetic coactivation as a signature of physical disgust, with the exception of mutilation-related disgust which seems to be characterized by sympathetic cardiac deactivation and unchanged vagal activation. Consistent with Kreibig's observations, the use of different samples and stimuli may have contributed to existing contradictory findings. In fact, according to a cognitive perspective on emotions (Scherer et al., 2001), different stimuli may be evaluated in different ways, and each individual may differently appraise the same stimulus, thus evoking

dissimilar affective states. Moreover, although disgust is more commonly experienced in association with the presence of contaminating agents in food, across cultures its verbal, facial and body expressions are also observed in response to socially obnoxious behaviors, such as cannibalism, pedophilia, and incest and also hypocrisy, servility, or betrayal (Haidt et al., 1997). Theorists in this field converge on the assumption that with the development of social norms, disgust has progressively developed to indicate the presence of other types of threat to the integrity of the individual, and conceptualized different sub-categories, such as core disgust, animal-reminder, interpersonal, and moral disgust (Rozin et al., 2000). The latter type of disgust, purely human, can be triggered by the presence of socially and morally 'harmful' individuals (Rozin et al., 2000; Schnall et al., 2008).

Although there are studies that aimed to identify the shared neural basis of physical and moral disgust (Mataix-Cols et al., 2008; Moll et al., 2005; Schaich et al., 2008), to date there is no empirical work on their psychophysiological correlates. Results from neuroimaging studies showed that physical and moral disgust recruited partially overlapping but distinct neural substrates (Mataix-Cols et al., 2008; Moll et al., 2005; Sambataro et al., 2006; Schaich et al., 2008). Empirical studies on the differences and similarities between physical and moral disgust are sparse and inconsistent (see Chapman and Anderson, 2012 for a review). The association between physical and moral purity was demonstrated in a series of studies in which participants were more likely to think of cleansing-related words and desired to engage in cleansing behavior after recalling a moral transgression (Lee and Schwarz, 2010; Zhong and Liljenquist, 2006). Similarly, participants

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perceived moral transgressions as less serious if they had to judge the latter during a feeling of cleanliness (Schnall et al., 2008). As to the biological homology, Chapman et al. (2009) found the same oral–nasal rejection facial expression in response to both physical contamination and moral violations.

The present study represents an attempt to a) reconcile previous findings on the psychophysiological correlates of disgust, b) empirically contribute to the understanding of the experience of disgust associated with different stimuli (i.e., physical vs moral), and c) study the role of individual differences with regard to the disposition to feel disgust. Our hypotheses are driven by the general assumption that the type and the intensity of affective reactions are a function of individual appraisals and ongoing relevant goals (Scherer et al., 2001). As far as disgust is concerned, we assume that the observed reaction would reflect beliefs related to the expectation to contamination or the perceived degree of contamination, and would support the aims to avoid the contaminant agent or to eliminate it from the self. For example, in the case of moral disgust, if we are watching a report on a corrupted politician belonging to our party, our reaction will probably be characterized by indignation words and a disgusted face, serving the primary goal to avoid any association with the transgressor. The same experience would be appraised as contaminating if the same politician shakes hands with us, in which case the motivated action tendency will be that of washing our hands to achieve purification. Since socially obnoxious behaviors are usually perceived as intentional and do not necessarily imply a violation of body boundaries, they are likely to elicit moral disgust as well as emotions related to appraisals of unfairness and interpersonal devaluation. In agreement with this view, we hypothesized that the physiological signature of disgust (vasovagal response), functional to oral expulsion, would be mainly observed in response to perceived physical contamination. Conversely, we expected that moral transgressions would evoke mixed feeling of anger, contempt, indignation, and disgust, thus eliciting a blended physiological response. Consistently, previous findings from self-report studies showed that anger and disgust are strongly correlated emotions of moral disapproval (Giner-Sorolla et al., 2012).

The relevance of the present study also emerges if we consider the role of disgust in clinical disorders. For example, obsessive–compulsive disorder (OCD) is characterized by exaggerated fear of and feelings of contamination that frequently induce OCD individuals to have obsessions and behavioral compulsions for avoiding contamination (American Psychiatric Association, 2000, Diagnostic and Statistical Manual of Mental Disorders 4th ed., text rev.; DSM-IV-TR). Disgust has been hypothesized to play a role in contamination obsessions and washing compulsions in OCD (Berle and Phillips, 2006; Mancini et al., 2001). Moreover, several models of OCD explain contamination fear by constructs related to morality (Mancini and Gangemi, 2004). For example, OCD patients are characterized by an inflated responsibility for preventing harm (Salkovskis, 1985), that positively correlates with the severity of symptoms (Salkovskis et al., 2000). Consistently, we hypothesized that participants with OCD tendencies, when faced with either physically or morally disgusting stimuli, would show an emotional response consistent with the appraisal of an ongoing contamination.

In sum, from a psychophysiological perspective, we expect that by eliciting physical disgust a more distinct vasovagal response would be observed in comparison to moral disgust, that in turn would be characterized by a sympathetic reaction. According to our hypotheses, this distinction does not obtain in individuals with OCD tendencies, who would show a vasovagal response even when faced with moral transgressions.

## 2. Materials and methods

### 2.1. Participants

The sample was composed of university students who received credit for participation: 20 men and 20 women, age range 20–39 years.

The mean age was 27.2 years (SD = 5.9) for female and 30.3 years (SD = 5.0) for male subjects. All subjects were Caucasian. Exclusionary criteria were psychiatric disorders, diagnosis of diseases or use of drugs/medications that might affect cardiovascular function, obesity (body mass index > 30 kg/m<sup>2</sup>), menopause, use of oral contraceptives during the previous 6 months, and pregnancy or childbirth within the last 12 months. The protocol was approved by the local Ethics Committee.

### 2.2. Procedure

Participants were asked to refrain from a) eating, b) drinking alcohol, tea, or coffee, and c) strenuous exercise 2 h preceding the scheduled appointment. Participants were seated in a comfortable chair in an experimental room. After providing written informed consent, participants were instrumented for cardiovascular monitoring. Half of the men (n = 10) and half of the women (n = 10) were randomly assigned to the physical disgust condition, while the other participants were assigned to the moral disgust condition. The experimental protocol consisted of: a) 5 min rest, b) subjective rating of emotions (pre), c) 3-min disgust induction (physical or moral), d) subjective rating of emotions (post), and e) questionnaires.

#### 2.2.1. Disgust induction

Although Rozin et al. (2000) conceptualized the existence of different sub-categories, such as core disgust, animal-reminder, and interpersonal disgust, here we will include such categories under the umbrella term of physical disgust (see also Chapman and Anderson, 2012), as this distinction goes beyond the aim of our study. As to moral disgust, we selected a stimulus (i.e., consensual incest) that is not intrinsically supposed to elicit anger as: a) language is more strongly related to representations of disgust when the moral transgressions refer to body-related violations (Gutierrez et al., 2012); b) whereas anger seems to respond to cues of harm and intentionality, disgust responds uniquely to bodily norm violations (Russell and Giner-Sorolla, 2011); and c) evolutionary psychology posited that disgust evolved to solve the problem of incest, that is a sexual behavior with deleterious consequences (e.g., Lieberman et al., 2007). Moral and physical disgust were induced by two different pre-recorded scripts selected from five scripts used in previous studies and adapted for each condition (moral and physical disgust). An initial pilot test assessed whether these scripts actually served to elicit disgust. To do so, 20 university students were asked to report which specific emotion was evoked by each script, as well as the degree to which they felt the respective emotion. Also, they were asked to rate both scripts on dimensions of valence and arousal. Among the ten scripts used, we selected one moral and one physical disgust-inducing script paired for valence and arousal.

The scripts required participants to listen to a vivid description of one of the following scenes: 1) an old man who is vomiting (physical disgust script; adapted from van Overveld et al., 2009); 2) an incestuous act between parent and child (moral disgust script; adapted from Parkinson et al., 2011). As in the pilot study, we observed that moral disgust was elicited as a function of the parent's gender, which was always the opposite gender of the participant (i.e., a mother and her son if the participant was a male and a father and his daughter if the participant was a female). Specific details regarding the scripts can be obtained by contacting the authors. Scripts were stored as audio files (16 bit wav-files) in the lab PC and presented via headphones. The duration of each script was 3 min.

### 2.3. Visual analogue scales

After the baseline period and disgust induction, participants were asked to rate their current levels of feeling happy, scornful, angry, disgusted, dirty, sexually excited, and indignant on separate visual analogue 100-point scales.

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