Autonomic correlates of physical and moral disgust

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A R T I C L E   I N F O

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

A B S T R A C T

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; Rohrmann 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 differentially 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
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 disagreement (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/m²), 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 head phones. 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.
2.4. Personality scales
In light of the role of disgust sensitivity and obsessive compulsive tendencies insubjective (Stark et al., 2005) and physiological responses (Rohrmann and Hopp, 2008) to disgusting stimuli, the following questionnaires were administered and used as covariates in the analyses: the Obsessive–Compulsive Inventory-Revised (OCI-R; Foa et al., 1998) as a measure of the presence and severity of obsessions and compulsions and the Disgust Scale–Revised (DS-R; Olatunji et al., 2007) as a measure of individual differences in sensitivity to disgust. The Italian version of the OCI showed good internal consistency and temporal stability and proved to be a reliable and valid measure of obsessive compulsive symptoms in Italian participants (Sica et al., 2009). In addition to a total score, the OCI-R has six subscales: washing, checking, ordering, obsessing, hoarding, and neutralizing. The Italian translation of the Disgust Scale Revised confirmed the Three-Factor Structure and showed good psychometric properties (Olatunji et al., 2009). Cronbach’s alpha coefficients for the OCI-R and the DS-R were greater than .75 in the present study.
Considering that a disgust reaction to moral transgressions is strictly connected with personal values and can be influenced by religious affiliation (e.g., Ritter and Preston, 2011), baseline differences between the two groups on these two factors were taken into account by the use of: a) the Portrait Values Questionnaire (PVQ; Schwartz et al., 2005) to assess the role of Tradition (‘respect, commitment and acceptance of the customs and ideas that traditional culture or religion provide’) and Conformity (‘restraint of actions, inclinations and impulses likely to upset or harm others and violate social expectations or norms’) and b) questions about participants’ religious beliefs; i.e., ‘independent of the type of religion, do you consider yourself as a religious believer?’ (Yes/No), ‘Are you a churchgoer?’ (Yes/No), ‘If so, how many church services did you attend in the past month?’ (0, 1, 2–5, >5).

2.5. Psychophysiological measures
The electrocardiogram (ECG) was continuously monitored (Monitoring, Adatec s.r.l., Italy) with a standard electrode configuration (right clavicle and precordial site V6). Three disposable Ag–AgCl electrodes were used. The ECG signal was digitized at 1000 Hz and inspected offline using Monitoring software (Adatec s.r.l., Italy). Successive R waves (identified by an automatic beat detection algorithm) were visually inspected, and any irregularities were edited. Successive interbeat intervals (in milliseconds) within each period (baseline and disgust induction) were written to single text files. As short-term recordings (e.g., <5 min) are considered inadequate to assess very low frequency HRV, approximately 1 min is needed to assess the HF components of HRV and approximately 2 min is needed to assess the LF component (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). Thus, both time (root mean square successive difference, RMSSD) and frequency (low-frequency HRV, LF-HRV, high-frequency HRV, HF-HRV, and LF/HF-HRV) domain measures of HRV were then obtained using HRV Analysis Software (Niskanen et al., 2004). According to the Task Force guidelines, the RMSSD reflects the integrity of vagus nerve–mediated autonomic control of the heart, the HF-HRV reflects parasympathetic activity, and the LF-HRV is proportional to sympathetic activity but influenced by parasympathetic tone. The interpretation of LF-HRV as primarily an index of sympathetic tone has been commonly derived by the calculation of the ratio of LF/HF-HRV.

3. Data analysis
Data processing was performed using Systat 9.0 (Systat Software Inc., Richmond, CA). Only significant (p < .05) results are reported. To evaluate the effects of socio-demographic factors, Pearson correlations were performed between BMI, age, and baseline levels of HR, RMSSD, HF-HRV, LF-HRV, and LF/HF.

To control for the presence of preexisting differences between the physical disgust and the moral disgust subgroups, two sample t-tests were computed on the following variables: age, obsessive–compulsive tendencies, disgust sensitivity, tradition and conformity dimensions of the PVQ, and baseline levels of each emotion, HR, RMSSD, HF-HRV, LF-HRV, and LF/HF. Chi square comparison was conducted for religious beliefs. Given that only one subject reported to be a churchgoer, this variable was not included in the preliminary analyses.

Low LF-HRV and HF-HRV were natural-log transformed (ln) because their distributions were highly skewed.
A series of 2 × 2 × 2 general linear models (GLMs) with script (physical disgust vs moral disgust) and gender as between subject variables and time (baseline, induction) as a within subject variable were conducted on HR, RMSSD, HF-HRV, LF-HRV, LF/HF, and each considered emotion. To control for individual differences, baseline levels of HR, RMSSD, HF-HRV, LF-HRV, LF/HF, and each considered emotion were respectively included in each model as a covariate. To control for obsessive compulsive tendencies and disgust sensitivity, scores at OCI-R and DS-R questionnaires were also included as covariates in each model. In sum, all the GLMs included baseline levels, OCI-R, and DS-R scores as covariates. Partial eta-squared (η²) and Cohen’s d were calculated to quantify the effect sizes of HR, HRV-related measures, and each emotion.

4. Results
Baseline differences between the physical disgust and the moral disgust groups were not significant for the examined variables (see Table 1). Chi square tests showed no differences between the two groups for religious beliefs.
Pearson correlations showed an association between age and baseline HR (r = −.41; p = .01) and OCI-R scores and baseline RMSSD (r = −.33; p = .04) and lnHF-HRV (r = −.33; p = .04). With regard to gender differences, women had higher scores (65.2 (12.1)) compared to men (56.7 (13.5)) on the disgust sensitivity scale, t (38) = 2.09; p = .04; Cohen’s d = .66.
Results concerning the psychophysiological variables are depicted in Fig. 1. For HR, the GLM revealed a significant main effect of time, F (1, 34) = 29.1, p < .0001; η² = .28 and a significant script × time interaction, F (1, 34) = 4.56, p = .04; η² = .04. T-test comparisons showed that HR did not change during the physical disgust induction but it significantly increased during the moral disgust induction, t (19) = −3.68, p = .002; Cohen’s d = .99. For RMSSD, the GLM revealed a significant script × time interaction, F (1, 34) = 28.97, p < .0001; η² = .21. Opposite patterns emerged for the physical and moral disgust subgroups.

### Table 1
<table>
<thead>
<tr>
<th>Variable</th>
<th>Physical</th>
<th>Moral</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>26.8 (5.7)</td>
<td>28.1 (6.8)</td>
<td>−.55</td>
</tr>
<tr>
<td>Tradition (PVQ)</td>
<td>4.6 (2.3)</td>
<td>5.2 (2.4)</td>
<td>−.85</td>
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<tr>
<td>Conformism (PVQ)</td>
<td>7.5 (3.1)</td>
<td>7.1 (3.4)</td>
<td>0.39</td>
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<tr>
<td>DS-R</td>
<td>59.4 (17.4)</td>
<td>64.7 (10.5)</td>
<td>−.98</td>
</tr>
<tr>
<td>OCI-R</td>
<td>11.4 (9.2)</td>
<td>7.8 (5.1)</td>
<td>1.32</td>
</tr>
<tr>
<td>Happy</td>
<td>43.3 (24.0)</td>
<td>51.1 (29.4)</td>
<td>−.81</td>
</tr>
<tr>
<td>Scornful</td>
<td>15.9 (21.8)</td>
<td>9.2 (14.3)</td>
<td>1.03</td>
</tr>
<tr>
<td>Angry</td>
<td>18.9 (28.8)</td>
<td>15.4 (24.3)</td>
<td>0.38</td>
</tr>
<tr>
<td>Disgusted</td>
<td>6.6 (13.8)</td>
<td>5.5 (10.4)</td>
<td>0.23</td>
</tr>
<tr>
<td>Indignant</td>
<td>21.9 (29.3)</td>
<td>8.7 (16.4)</td>
<td>1.60</td>
</tr>
<tr>
<td>Dirty</td>
<td>8.1 (13.6)</td>
<td>8.1 (14.9)</td>
<td>0.00</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>83.6 (11.3)</td>
<td>77.6 (7.9)</td>
<td>1.94</td>
</tr>
<tr>
<td>RMSSD (ms²)</td>
<td>31.7 (8.4)</td>
<td>38.2 (10.7)</td>
<td>−.14</td>
</tr>
<tr>
<td>HF-HRV (ms²)</td>
<td>1022.6 (507.4)</td>
<td>1126.2 (444.5)</td>
<td>−.69</td>
</tr>
<tr>
<td>LF-HRV (ms²)</td>
<td>936.7 (692.7)</td>
<td>770.0 (404.4)</td>
<td>0.93</td>
</tr>
<tr>
<td>LF/HF</td>
<td>1.13 (0.14)</td>
<td>1.10 (0.22)</td>
<td>0.74</td>
</tr>
</tbody>
</table>
moral disgust conditions: whereas there was a RMSSD increase during the first $t (19) = -2.46, p = .02$; Cohen's $d = .66$, moral disgust yielded a significant decrease in RMSSD, $t (19) = 3.40, p = .003$; Cohen's $d = 1.2$. For lnHF-HRV, the GLM revealed significant script × time, $F (1, 34) = 4.69, p = .05$; $\eta^2 = .10$ and time × OCI-R interactions, $F (1, 34) = 8.17, p = .01$; $\eta^2 = .13$. T-test comparisons showed a significant increase in lnHF-HRV for the physical disgust induction, $t (19) = -2.02, p = .05$; Cohen's $d = .41$. Using a median split, regardless of induction type, high-OCI participants showed an increase in HF-HRV from baseline to induction, $t (19) = -2.25, p = .04$; Cohen's $d = .67$ (see Fig. 3a). For LF/HF, a significant script × time interaction was found, $F (1, 34) = 4.96, p = .03$; $\eta^2 = .12$, showing an increase in autonomic imbalance towards sympathetic control during moral disgust $t (19) = -2.14, p = .04$; Cohen's $d = .57$. No significant effects emerged for LF-HRV.

Fig. 2 shows the differences in emotion change scores for the physical and moral disgust conditions. A significant time × DS-R interaction emerged for Disgusted, $F (1, 34) = 11.17, p = .002$; $\eta^2 = .21$. Using a median split, high-DS showed significantly greater increases in disgust levels compared to low-DS participants, $t (38) = 2.79, p = .01$; Cohen's $d = .71$ (see Fig. 3b). Significant script × time interactions were found for Indignant ($F (1, 34) = 9.63, p = .004$; $\eta^2 = .23$), Scornful ($F (1, 34) = 9.63, p = .004$; $\eta^2 = .15$), and Dirty ($F (2, 34) = 9.92, p = .004$; $\eta^2 = .19$). T-test comparisons suggest that participants felt more scornful and indignant after the moral disgust induction ($t (19) = -4.10, p = .001$; Cohen's $d = 1.23$ and $t (19) = -5.11, p < .0001$; Cohen's $d = 1.10$, respectively) but not the physical disgust induction. Conversely, participants felt dirtier only after the physical disgust induction ($t (19) = 3.48, p = .002$; Cohen's $d = 1.07$). No other significant effects or interactions emerged.

5. Discussion

The major aim of the present study was to establish whether physical and moral disgust vary in their subjective and physiological...
correlates. Results confirmed distinct response patterns evoked by these two types of disgust. With regard to the subjective experiences, both scripts evoked disgust, but the physical script also elicited a feeling of dirtiness and the moral script elicited indignation and contempt. The disgust-induced subjective indicators were mimicked by opposite patterns of autonomic reactivity: enhanced activity of the parasympathetic nervous system (increased HRV) during physical disgust and decreased activity of the same branch of the autonomic nervous system accompanied by sympathetic dominance (i.e., autonomic imbalance) during moral disgust. Moreover, whereas HR did not change during induction of physical disgust, it significantly increased during the incest script.

The cardiac pattern that emerged during physical disgust replicated previous findings obtained by the use of video clips (De Jong et al., 2011; Rohrmann and Hopp, 2008) with a different induction method (i.e., vocal script). Moreover, our findings support the hypothesis that the lack of parasympathetic responses (e.g., Van Overveld et al., 2009) or even increases in HR (Alaoui-Ismaili et al., 1997; Schienle et al., 2001; Vernet-Maury et al., 1999) reported in previous studies may be due to the mental effort required by the use of their imagination procedures (De Jong et al., 2011).

The autonomic pattern that emerged for moral disgust seems to resemble the physiological signature of anger rather than disgust (Levenson, 1992). It is true that participants reported that they were much more scornful and indignant compared to angry. Yet, we have been suggested that indignation differs from anger in that its criteria are more strongly moral than in the case of anger (Solomon, 1993), and contempt has been considered to be derived from a combination of disgust and anger (Power and Dalgleish, 2008). Yet, we know that anger, indignation, and contempt commonly occur in negative social interactions and imply a negative appraisal of the intentions of the other person (e.g., Frijda et al., 1989). In line with this approach, we will discuss our results with reference to anger but implying by this term the emotions of indignation and contempt.

Indeed, anger and disgust are important components of moral judgment in general (e.g., Haidt, 2003). Our finding contradicts the CAD triad hypothesis (Rozin et al., 1999b), according to which anger and disgust respond to different forms of moral violation, that is violations of autonomy ethics (concerns with harm and rights) and violations of religious ethics (concerns with purity and use of the body). This hypothesis has been empirically supported by Giner-Sorolla et al. (2012) and Gutierrez et al. (2012) who showed the existence of separate elicitors of disgust and anger, that is behaviors involving sex and betrayal. In agreement with our findings, however, Gutierrez and Giner-Sorolla (2007) showed that disgust words in response to unusual but consensual sex act were equally predicted by anger words and disgusted faces. Moreover, Schach et al. (2008) provided evidence that, despite their tendency to elicit similar ratings of disgust, pathogen-related acts and incest-related acts elicit different but overlapping brain networks.

Although moral disgust has been theoretically linked to contamination-based disgust, the notion that such diverse stimuli as potential disease vectors and incest are able to trigger a common physiological and subjective experience of revulsion has not received consistent empirical support (see Chapman et al., 2009 for a review). Our data seem to suggest that these two reactions may be only linguistically analogous, as expressed in the metaphor of ‘the bad taste’ of moral disgust. The subjective feeling of disgust reported by participants after the moral transgressions might have been co-opted to promote withdrawal from transgressors, or from the thought of committing a transgression. Contrary to previous studies that suggested that moral disgust elicited a sense of dirtiness in the participants (e.g., Zhong and Liljenquist, 2006), participants only reported this feeling after the physical disgust induction. It has to be noted, however, that, unlike in our study, the sense of dirtiness has always been assessed implicitly, for example by asking subjects to choose among different gadgets such as antiseptic wipes or pens (Zhong and Liljenquist, 2006). Considering that Zhong and Liljenquist (2006) required the recall of an unethical deed from participants’ past, inconsistencies of results may also be due to the fact that participants felt differently involved in the disgusting scenes (i.e., actor versus spectator). Future studies are needed to replicate our findings by the use of incest scripts that are likely to elicit a stronger identification, such as with subjects’ acquaintances or friends as the main characters.

In agreement with previous findings, people with relatively high scores on disgust sensitivity, also indicated the experience of more intense disgust during both scripts (e.g., De Jong et al., 2011; Stark et al., 2005).

Intriguingly, OCI-R scores were associated with vocal tone increases regardless of induction type, that is participants with obsessive compulsive tendencies showed the autonomic signature of disgust also during the moral script. In terms of appraisal, we can speculate that these subjects may have interpreted immorality as potentially contaminating. This result is clinically relevant if we consider that, unlike the other anxiety disorders, obsessive compulsive disorder (OCD) has been defined as a disorder of morality (Shapiro and Stewart, 2011) in light of its association with heightened moral sensitivity (Harrison et al., 2012) and inflated responsibility (Mancini and Gangemi, 2004). As to gender differences, women on average scored higher in the disgust sensitivity scale than men, while physiological disgust responses were independent of gender, as also shown by Rohrmann and Hopp (2008), and Caseras et al. (2007). In only one study, women also showed higher increases in HR to disgust elicitation compared to men (Fernández et al., 2012). Although men and women had an identical physiological reaction to disgusting stimuli, women tended to perceive themselves as more vulnerable to this specific emotion. Our data showed that this was not due to the fact that women are more traditionalist or conservative. Conversely, there are data suggesting that this may be an adaptive mechanism as it has been shown that people have more exaggerated responses to disgust-eliciting cues when the body’s actual immunological defenses are temporarily suppressed. For example, women in their first trimester of pregnancy, during which the immune system is naturally suppressed, exhibited heightened ethnocentric and xenophobic attitudes (Navarrete et al., 2007). Moreover, women showed increased aversion to unhealthy faces when progesterone level was high compared to when it was low (Jones et al., 2005).

Several limitations need to be acknowledged. First, the sample size was relatively small and may not have been adequate in some of the comparisons. Indeed, this was the first study on the autonomic correlates of physical and moral disgust and therefore should be considered exploratory. Even if our effect sizes were medium to large, further studies with larger sample sizes are needed to validate present findings. Second, the present study was restricted to broad categories of disgust, thus ignoring the subtypes that have been conceptualized (Haidt et al., 1997; Lieberman et al., 2007). For example, Parkinson et al. (2011) found that moral judgment itself is not a wholly unified faculty in the human brain as dissociable neural systems are engaged differentially depending on the type of transgression being judged. Moreover, despite the fact that the Italian word “eccitato” specifically refers to sexual excitement and showed no significant effects, we cannot completely exclude that differences in parasympathetic nervous system activity between the two scripts were due to a sexually arousing effect of the moral script compared to the physical script. Reporting sexual arousal to an incestuous scenario violates social norms, therefore findings might be biased by social desirability. Future studies with the use of a within-subjects design and a deeper evaluation of individual differences in subjects’ values, beliefs, or related prior experiences with and about the different kinds of events related to the scripts are needed to replicate and support our findings.
Limitations notwithstanding, results suggest that moral disgust is distinct from the most primitive forms of disgust related to the ingestion of potential toxins, having been differentiated from the ancient oral distaste response rooted in chemical sensory rejection.

Acknowledgements

The authors are grateful to Prof. David Shapiro for his valuable comments and to Federica Salerno for her assistance in data collection and entry.

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