

Verbal Priming and Taste Sensitivity Make Moral Transgressions Gross

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The aims of the present study were to assess whether: (a) visceral and moral disgust share a common oral origin (taste); (b) moral transgressions that are also viscerally involving are evaluated accordingly as a function of individual differences in taste sensitivity; (c) verbal priming interacts with taste sensitivity to alter how disgust is experienced in moral transgressions; and (d) whether gender moderates these effects. Standard tests of disgust sensitivity, a questionnaire developed for this research assessing different types of moral transgressions (nonvisceral, implied-visceral, visceral) with the terms “angry” and “grossed-out,” and a taste sensitivity test of 6-*n*-propylthiouracil (PROP) were administered to 102 participants. Results confirmed past findings that the more sensitive to PROP a participant was the more disgusted they were by visceral, but not moral, disgust elicitors. Importantly, the findings newly revealed that taste sensitivity had no bearing on evaluations of moral transgressions, regardless of their visceral nature, when “angry” was the emotion primed. However, when “grossed-out” was primed for evaluating moral violations, the more intense PROP tasted to a participant the more “grossed-out” they were by all transgressions. Women were generally more disgust sensitive and morally condemning than men, but disgust test, transgression type, and priming scale modulated these effects. The present findings support the proposition that moral and visceral disgust do not share a common oral origin, but show that linguistic priming can transform a moral transgression into a viscerally repulsive event and that susceptibility to this priming varies as a function of an individual’s sensitivity to the origins of visceral disgust—bitter taste.

Keywords: taste sensitivity, emotion, disgust, moral, visceral

Disgust is considered to be one of the six basic emotions—emotions that any healthy human no matter who they are, or where they are from can recognize and experience (Darwin, 1872/1965; Ekman & Friesen, 1975; Levenson, 2011). Each of the basic emotions has a specific facial expression and mental state associated to it. When we are disgusted, our thoughts and feelings vary from mild negativity to overwhelming revulsion, but they all center around the urge to avoid that which is causing the feeling. In the state of disgust, our face displays a highly specified set of muscle contortions: the mouth grimaces or opens (the tongue may also extend), the nose wrinkles, and the upper lip retracts while the lower lip protrudes (see Rozin, Haidt, & McCauley, 2008 for discussion).

Notably, the facial expression made to disgust elicitors such as, seeing maggots on a piece of meat, is the same facial expression that is instinctively made to bitter tastes—stimuli which generally signal poisons (Ekman & Friesen, 1975; Steiner, 1979). Correspondingly, it is widely held that the emotion of disgust originated from the oral rejection of bitter taste as a defense mechanism to protect against ingestion of poisonous or spoiled foods, and has evolved into reactions to a wide repertoire of elicitors that range

from rotted food to morality (Haidt, McCauley, & Rozin, 1994; Rozin & Fallon, 1987; Rozin et al., 2008). Importantly it has been shown that the focal neurological site for disgust processing is the anterior insula, which is also the primary taste cortex (Kringelbach, de Araujo, & Rolls, 2004; Phillips et al., 1997; Small, 2010; Wicker et al., 2003; Wright, He, Shapira, Goodman, & Liu, 2004). Thus, processing and perception of taste and disgust appear to share the same neurological locus. Nevertheless, the uniformity of the emotional state experienced when one is “disgusted” is intensely debated.

The emotion of disgust is variously defined as activated by: (a) “core” elicitors including: rotted food, bodily fluids, gore, being reminded of one’s animal nature, contamination, disease, death; (b) sexuality (e.g., masturbation); and (c) morality (e.g., cheating, stealing; see Curtis, Aunger, & Rabie, 2004; Oaten, Stevenson, & Case, 2009; Rozin et al., 2008, and Tybur, Griskevicius, & Lieberman, 2009, for reviews). Most contested is whether the emotional response to elicitors such as bodily fluids, rotted food, vermin, and disease is fundamentally the same as the emotional response that is elicited by moral transgressions such as lying and stealing.

Given that the facial expression to bitter compounds and visceral disgust elicitors is the same, a compelling research approach is to assess the relationship between bitter taste and moral disgust. Chapman, Kim, Susskind, and Anderson (2009) examined participants’ facial expressions to the taste of a bitter substance (quinine) and various divisions of money in an “ultimatum game.” Results showed that both the taste of quinine and very unfair propositions of monetary divisions (\$9 for proposer, \$1 for receiver) elicited activation of the levator labii muscle region of the face, which raises the upper lip and wrinkles the nose. In other words, the

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facial expression participants made to bitter taste was similar to the face they made when there were cheated out of money. Along the same lines, Eskine, Kacinik, and Prinz (2011) reported that priming participants with the taste of bitter intensified judgments of moral wrongness.

In contrast to reports of the taste connection to moral disgust, my laboratory found a connection between taste sensitivity and reactivity to visceral disgust elicitors, but not moral disgust elicitors. Using 6-*n*-propylthiouracil (PROP), I found that sensitivity to this bitter compound was positively related to feelings of visceral disgust toward elicitors such as body fluids and disease, but unrelated to feelings of moral disgust elicited by autonomy violations—transgressions that involve harm, fairness, or the infringement of rights (Herz, 2011). The explanation proposed was that greater responsiveness to visceral disgust develops through a lifetime of intense activation of the anterior insula by oral sensations. Thus, as a result of continuously greater stimulation among individuals who are highly taste sensitive their anterior insula's become more sensitized to other stimuli that activate the insula as well (e.g., disgust elicitors) compared with individuals who are less taste sensitive (Herz, 2011).

In the disgust-morality literature, an underlying problem with some important studies has been an unclear distinction between moral violations of autonomy and moral transgression that include a visceral component. For example, in Eskine et al. (2011) vignettes were tested that included both autonomy (bribery, theft) and moral violations with a visceral element (eating one's dog, incest), yet responses to the vignettes were analyzed as a whole. However, several other research groups have shown that when different forms of disgust are compared, visceral and nonvisceral moral disgust scenarios are responded to differently (e.g., Helzer & Pizarro, 2011; Parkinson et al., 2011).

Emotion words have also been used as a marker to distinguish visceral and moral disgust. For example, we recently found that people use the terms "angry" and "disgusted" equivalently when referring to the feelings elicited by autonomy violations, but that "grossed-out," which is colloquially reserved for feelings of visceral disgust, was only weakly endorsed toward autonomy violations (Herz & Hinds, 2013). Similar results have been reported by a number of other researchers (Danovitch & Bloom, 2009; Gutierrez, Giner-Sorolla, & Vasiljevic, 2012; Hutcherson & Gross, 2011; Nabi, 2002; Widen & Russell, 2010). Notably, in our study (Herz & Hinds, 2013) ratings for "grossed-out" were not at floor, which would have been predicted if the term were totally meaningless in the context of autonomy violations. Two possible explanations were offered: (a) participants could only rate the violations with "grossed-out" and because they needed to convey their disapproval, they were forced to endorse this evaluation to some degree; and (b) the term "grossed-out" primed feelings of visceral disgust as per Damasio's *somatic marker hypothesis* (Damasio, 1994) and these feelings made participants experience the autonomy violations as somewhat viscerally disgusting—hence enabling endorsement of the "grossed-out" scale. According to the somatic marker hypothesis, when a specific emotional reaction to a situation is frequently experienced, the same part of the brain that controls that reaction when the situation is actually occurring can be activated simply by thinking about it, thus producing a similar internal state as the actual experience (Damasio, 1994).

The aims of the present study were to further address the debate over the uniformity of visceral and moral disgust, reconcile methodological issues in past studies where visceral and nonvisceral moral transgressions have been mixed together, and expand upon our previous findings concerning taste sensitivity, linguistic priming, and sensitivity to various types of disgust. Specifically, this study sought to: (a) confirm past findings regarding the oral-taste connection for visceral, but not moral disgust; (b) assess whether moral transgressions that are also viscerally involving are evaluated accordingly as a function of individual differences in taste sensitivity; (c) examine whether verbal priming interacts with taste sensitivity to alter how disgust is experienced in moral transgressions; and (d) examine whether gender modulates these effects, as it has been shown that women generally have more intense disgust reactions and respond more intensely to moral transgressions than men do (Aleman & Swart, 2008; Davey, 1994; Haidt et al., 1994; Herz & Hinds, 2013).

Hypothesis 1, replication of past results: It was hypothesized that taste sensitivity would be correlated with measures of visceral disgust sensitivity (rotted food, disease), but not with sensitivity to moral violations of autonomy (lying, stealing).

Hypothesis 2, the relationship between taste sensitivity and different types of moral disgust: It was hypothesized that if all moral transgressions activate the same emotional disgust response then the presumed substrate for this reactivity (taste sensitivity) should be equivalently (un)related to all types of moral transgressions. However, if responses to moral violations do relate to taste sensitivity when visceral disgust is additionally experienced, then responses to autonomy violations should not correspond to taste sensitivity, but responses to moral transgressions that include a visceral component should reflect taste sensitivity to corresponding degrees.

Hypothesis 3, somatic verbal priming induces visceral disgust toward moral violations: It was hypothesized that if somatic effects are primed by exposure to the term "grossed-out" then the underlying taste connection to visceral disgust should be activated leading to: (a) a relationship between individual taste sensitivity and responding with the "grossed-out" scale, and (b) all moral violations becoming more viscerally disgusting in the context of "grossed-out." By contrast, no such effects were expected in the context of priming with the alternate negative emotion term "angry."

Hypothesis 4, gender differences: It was hypothesized that women would show greater disgust sensitivity and moral condemnation overall than men would.

Method

Participants

Participants were recruited from a large lecture course in the Cognitive, Linguistic and Psychological Sciences department at Brown University. One-hundred and two students (62 female, mean age 19.5 years) consented to partake in the main experiment. Fifteen (11 female, mean age 21.2) and 80 different student volunteers (64 female, mean age 19.6 years) respectively took part in

two pilot studies: (a) assigning vignettes described in the “Behavioral Situations Questionnaire” (see below) to the categories non-visceral, implied-visceral, visceral, and rating vignette visualizability; and (b) assessing the perceived morality-immorality of the vignettes. In all cases, participation was voluntary and no inducement or compensation was given.

Materials

Behavioral situations questionnaire. To examine emotional responses to moral transgressions that varied in viscerality, the “Behavioral Situations Questionnaire” (BSQ) was developed for this research and based in part on previously published studies assessing moral disgust (Gutierrez & Giner-Sorolla, 2007; Helzer & Pizarro, 2011). The BSQ comprised 12 vignettes, four described *nonvisceral* autonomy violations, four described moral violations with an *implied-visceral* component (i.e., there is a physically disturbing element but one needs to visualize the transgression in order to fully realize it), and four vignettes described *visceral* violations, where two were sexual and two were nonsexual (see Appendix).

Prior to the main experiment, the BSQ was pilot tested to establish that the vignettes met intended viscerality criteria, and to assess the perceived morality-immorality of each of the vignettes. Different groups of volunteers were tested in each of the pilot tests and main experiment so that repeated testing of the same vignettes would not confound the responses. One group of pilot test participants was asked to categorize each vignette for whether they thought it was a *nonvisceral*, *implied-visceral*, or *visceral* violation, according to the following definitions: nonvisceral, “The scenario doesn’t make me feel squeamish and/or doesn’t elicit feelings of physical repulsion;” implied-visceral, “When I think about the scenario and visualize it, I feel somewhat squeamish and/or it elicits feelings of physical repulsion;” visceral, “The scenario makes me feel squeamish and/or elicits feelings of physical repulsion.” Participants then rated the vignette for vividness of visualization on a 1–7 scale (1 = *Not at all vivid*, 7 = *Extremely vivid*). Results showed that 88% of the time intended *nonvisceral* vignettes were thus categorized, 78% of the time intended *implied-visceral* vignettes were thus categorized, and 85% of the time *visceral* vignettes were thus categorized. Importantly, participants rated the *implied-visceral* vignettes as significantly less vividly visualizable ($M = 4.75$, $SEM = 0.21$) than the *visceral* ($M = 6.12$, $SEM = 0.16$) and *nonvisceral* vignettes ($M = 5.67$, $SEM = 0.21$), $F(2, 118) = 12.93$, $p < .001$, $h^2 = 0.18$. *Nonvisceral* and *visceral* vignettes did not statistically differ in visualizability. Thus, it was deemed that the BSQ vignettes were appropriate for their respective category designations.

In a second pilot test, participants rated each vignette on a 9-point morality rating scale (1 = *totally morally right*, 9 = *totally morally wrong*) as in Herz and Hinds (2013). A repeated measures ANOVA and subsequent Newman–Keuls post hoc comparisons showed that the three vignette types were rated significantly differently from each other, $F(2, 158) = 126.7$, $p < .001$, $h^2 = 0.62$. As expected from prior research (Gutierrez & Giner-Sorolla, 2007; Haidt, 2001; Parkinson et al., 2012), *implied-visceral* vignettes were rated as least morally wrong ($M = 6.92 \pm SEM 0.9$), followed by *nonvisceral* vignettes ($M = 7.70 \pm SEM = 0.09$), and *visceral* vignettes were rated as most morally wrong ($M = 8.54 \pm$

$SEM = 0.07$). There is evidence that sexual moral transgressions are different from other types of visceral moral transgressions (Helzer & Pizarro, 2011; Parkinson et al., 2012; Tybur et al., 2009), therefore the two types of visceral transgressions were compared. A repeated measures ANOVA found that they were indeed different, $F(1, 79) = 15.95$, $p < .001$, $h^2 = 0.17$, with sexual vignettes rated as more morally wrong ($M = 8.70 \pm SEM = 0.07$) than nonsexual visceral vignettes ($M = 8.38 \pm SEM = 0.08$). As such, sexual and nonsexual vignettes were also compared in the main experiment.

For the main experiment, the BSQ was divided into two sections, each with six vignettes; two vignettes were *nonvisceral* violations, two were *implied-visceral* violations, and two were *visceral* violations, where one was sexual and one was nonsexual. To test whether verbal priming would induce somatic emotional effects and thereby influence responding to the various vignettes, one section of the BSQ asked participants to evaluate how “angry” the vignette made them feel (1 = *not at all angry*, 9 = *extremely angry*), thus priming the emotion of anger, and the other section asked how “grossed out” (1 = *not at all grossed-out*, 9 = *extremely grossed-out*) the vignettes made them feel, thus priming the emotion of visceral disgust. Four versions of the BSQ were prepared which reversed the order of “grossed-out” and “angry” sections and the vignettes within each section, which were also randomized.

Disgust sensitivity tests. To assess responsivity to various facets of disgust, two questionnaires were administered. (a) The 8-item short form of the Disgust Scale (DS) (Haidt et al., 1994; Herz, 2011; Herz & Hinds, 2013; Inbar, Pizarro, & Bloom, 2009) which evaluates responsivity to core-visceral disgust (rotted food, vermin, body fluids). For example, *You see a bowel movement left unflushed in a public toilet*. Depending upon the item, participants use either a 1–4 or 1–5 category scale to rate how much they *agree with* or are *disgusted by* the statement. The maximum score obtainable is 36 and the minimum is 8. (b) The Three-Domain Disgust Scale (TDDS; Tybur et al., 2009). The TDDS scale is currently the only disgust sensitivity measure with a subscale that explicitly measures moral disgust, specifically autonomy violations. Two other subscales assess disgust to sexuality and pathogens, respectively. There are seven items in each subscale; for example: *Watching a pornographic video* (sexuality subscale); *Accidentally touching a person’s bloody cut* (pathogen subscale); *A student cheating to get good grades* (morality subscale). Participants rate their response to each item using a 1–7 category scale (1 = *not at all disgusting*, 7 = *extremely disgusting*). The maximum score per subscale is 49 and the minimum is 7.

Taste sensitivity. Taste sensitivity was measured with 6-*n*-propylthiouracil (PROP), a standard biological assay used in evaluations of taste sensitivity (Bartoshuk, Duffy, & Miller, 1994; Herz, 2011; Lee, Prescott, & Kim, 2008; Mennella, Pepino, Duke, & Reed, 2011; Tepper, Neilland, Ullrich, Koelliker, & Belzer, 2011). Taste sensitivity is genetically determined. “Supertasters” are homozygotes (PAV/PAV) at the TAS2R38 gene locus on chromosome 5. They have a high number of fungiform papillae and experience intense oral sensations; they also experience PROP as extremely bitter tasting. Individuals who are heterozygous (AVI/PAV) at this gene locus, “tasters,” possess fewer fungiform papillae, experience moderate oral-taste sensations, and perceive PROP to be moderately bitter. “Nontasters” are homozygous (AVI/AVI) at this gene locus, possess the fewest fungiform papillae and cannot detect the

taste of PROP. Taste sensitivity as discussed in the present research refers specifically to superthreshold PROP taste ability as a presumed correlate of individuals' fungiform papillae number and density (more PROP sensitive individuals express higher number and density of fungiform papillae; Delwiche, Buletic, & Breslin, 2001; Duffy et al., 2004). PROP is not the only assay of taste sensitivity; however, it was considered an especially good measure for the present research because when it is perceived it's taste is bitter, thus connecting this measure with the presumed ontological origin of emotional disgust (Herz, 2011; Rozin et al., 2008).

PROP was administered as 1.6 mg saturated in round filter papers that were individually contained in small translucent envelopes. PROP sensitivity was measured with the General Labeled Magnitude Scale (gLMS; Bartoshuk et al., 2004). The gLMS is a vertical line scale partitioned into evenly distributed numerical increments of 0–100 with six semantic labels (barely detectable, weak, moderate, strong, very strong, strongest imaginable sensation of any kind) fixed at empirically determined points on the scale.

Procedure

An equal number of questionnaire packets comprising each of the four versions of the BSQ and the DS, TDDS, and gLMS along with the PROP filter paper envelopes were randomly distributed. Participants performed the experiment with the other volunteers in a large stadium style seating classroom. They were told that they would be answering several questionnaires and then "tasting" something. No mention of "sensitivity" as a factor of interest was made. The PROP paper was shown and the experimental use of PROP was briefly explained. Participants were told that individuals vary widely in their taste perception of this substance with some people unable to taste anything, and that all responses were normal and genetically determined. No indication as to what PROP might taste like if they could perceive it was offered. An explanation of the gLMS and nontaste examples of how it is used to measure the intensity of various experiences was then given. For example, the light from a candle seen from a distance on a dark night would be "barely detectable," and staring directly at the sun on a clear summer day would be an example of "the strongest imaginable sensation of any kind." Volunteers did not undergo any explicit practice trials with the gLMS before testing began.

Participants were instructed to pay attention to what was asked of them in the different questionnaires, to work quietly, and to complete the questionnaires in order (BSQ, DS, TDDS). When participants got to the last page with the gLMS they were told to open the envelope with the PROP filter paper and taste it by briefly placing it on their tongue, and then to mark an "X" on the gLMS corresponding to their experience of the sensation. PROP testing was conducted at the end so that taste would not confound the participant's responses to the other questionnaires. Lollipops were handed out as desired for relief after the PROP test.

Results

Tests of Hypothesis 1 and 4

To assess whether taste sensitivity was related to visceral but not moral disgust and thus replicate past results (Hypothesis 1), and to examine gender differences (Hypothesis 4), an analyses of cova-

riance (ANCOVA) was conducted on the responses from the DS and the TDDS, with taste sensitivity as the covariate, and gender as the between subjects factor. Taste sensitivity was measured by gLMS ratings of PROP. gLMS responses were examined as a continuous variable rather than allocating participants to discrete taster groups, because neither direct measurement of fungiform papillae nor genetic testing were performed and therefore taster status could not be confirmed. The three subscales of the TDDS were considered separately due to the aims of the present research.

Results from the DS revealed a significant main effect of taste sensitivity, $F(1, 99) 9.96, p < .001, h^2 = 0.09$. Correlational analysis showed that as PROP sensitivity increased so did disgust sensitivity, $r = .31, p < .01$. The effect of subject gender was not statistically reliable, $F(1, 99) = 0.12, (M\text{-female} = 23.20, SEM = 0.51; M\text{-male} = 22.50, SEM = 0.67)$. On the TDDS-pathogen subscale, main effects of taste sensitivity, $F(1, 99) 6.14, p < .01, h^2 = 0.06$, and gender $F(1, 99) 5.91, p < .01, h^2 = 0.05$, were obtained. Correlational analysis showed that the greater someone's taste sensitivity the greater their reactivity to pathogen disgust triggers, $r = .36, p < .01$. Newman-Keuls comparisons showed that women rated pathogen triggers as more disgusting ($M = 32.47 \pm SEM = 0.81$) than men did ($M = 28.77 \pm SEM = 2.06$). On the TDDS-sexual subscale a main effect of gender was also found, $F(1, 99) 36.03, p < .001, h^2 = 0.27$; women rated the items as much more disgusting ($M = 31.37 \pm SEM = 0.95$) than men did ($M = 21.90 \pm SEM = 1.18$). Taste sensitivity did not affect these ratings. Importantly, no effects or interactions as a function of taste sensitivity or gender were obtained for ratings on the TDDS-moral subscale. Figure 1 illustrates the relationship between PROP taste sensitivity and responding on the DS, and the various subscales of the TDDS.

Tests of Hypotheses 2, 3, and 4

To test the connection between taste sensitivity and responsivity to moral transgressions as a function of the transgression's visceral quality (Hypothesis 2), whether the language used to prime responses to moral transgressions could induce a somatic effect such that "grossed out" would engage the taste connection to moral disgust, but "angry" would not (Hypothesis 3), and if gender differences mediated any of the findings (Hypothesis 4), an ANCOVA was performed. PROP taste sensitivity (gLMS score) was the covariate, gender was the between-subjects variable, and moral type (nonvisceral, implied-visceral, visceral) and priming scale ("angry," "grossed-out") were within subjects factors.

Results revealed significant main effects for taste sensitivity, $F(1, 99) = 4.77, p < .05, h^2 = 0.04$, rating scale $F(1, 99) = 10.77, p < .001, h^2 = 0.09$, and moral type, $F(2, 198) = 68.42, p < .001, h^2 = 0.40$. Significant interactions for priming scale by taste sensitivity, $F(1, 99) = 4.74, p < .05, h^2 = 0.04$, priming scale by gender, $F(1, 99) = 3.94, p = .05, h^2 = 0.03$, and priming scale by moral type, $F(2, 198) = 11.25, p < .001, h^2 = 0.10$, were also obtained.

The main effect for priming scale indicated that participants gave higher scores to all transgressions with the "angry" scale ($M\text{-"angry"} = 6.81 \pm SEM = 0.13; M\text{-"grossed-out"} = 6.33 \pm SEM = 0.15$). The main effect for moral-type showed that non-visceral transgressions received the lowest ratings ($M = 5.60 \pm SEM = 0.17$), followed by implied-visceral transgressions ($M =$

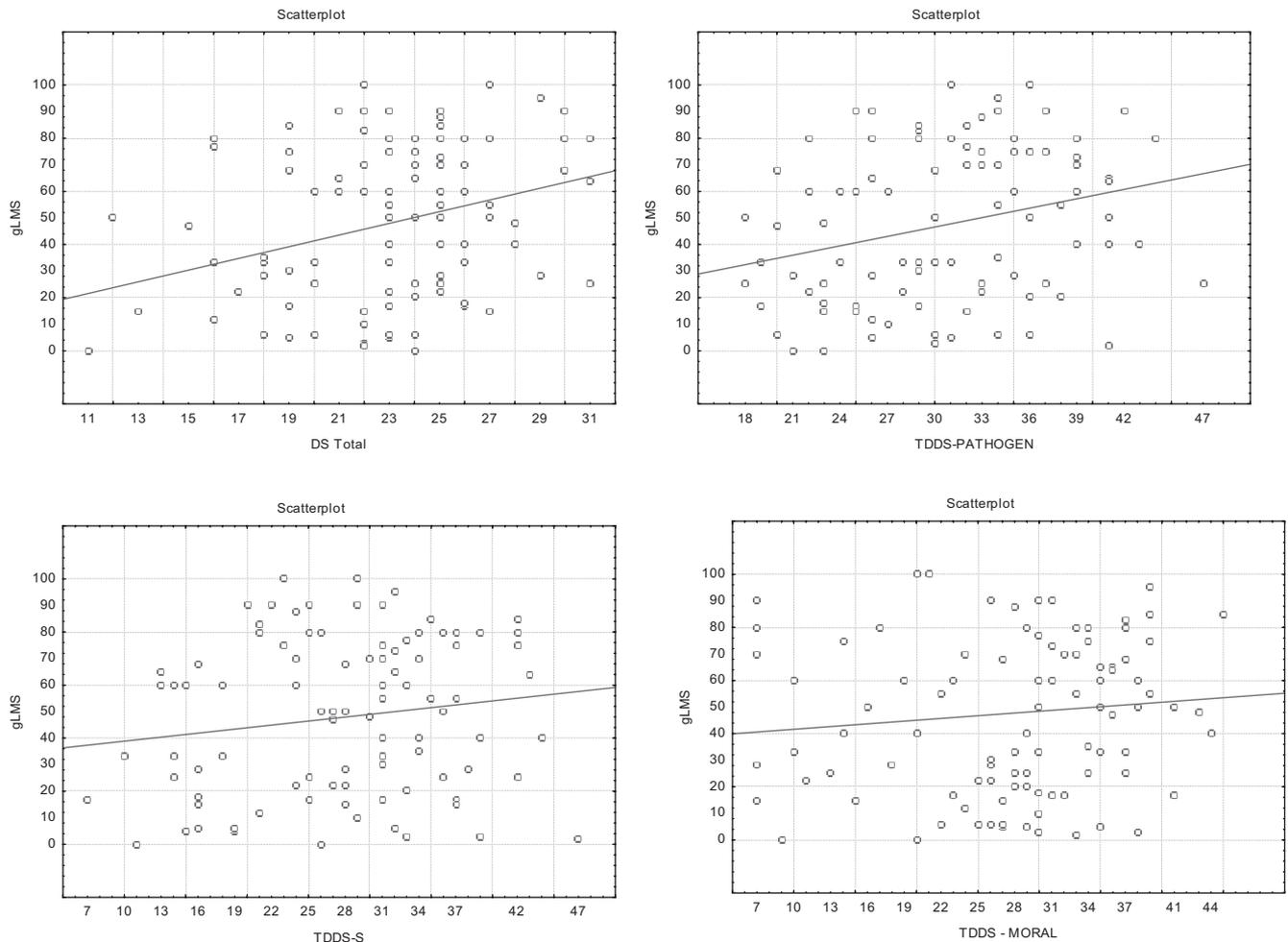


Figure 1. The relationship between taste sensitivity and responses on the DS and subscales of the TDDS. Scatterplots showing the significant positive relationship between taste sensitivity to PROP (gLMS) score with scores on the DS ($r = .31, p < .001$) and TDDS-pathogen subscale ($r = .27, p < .005$; top row), but no relationship with taste sensitivity to PROP and scores on the TDDS-sexual or TDDS-moral subscales ($r = .15, p = .12$; $r = .11, p = .27$ (bottom row).

$5.90 \pm SEM = 0.15$), followed by considerably higher ratings for visceral violations ($M = 8.23 \pm SEM = 0.10$).

Correlational examination of the priming scale by taste sensitivity interaction showed that taste had no bearing on the responses given to the various types of moral transgressions when “angry” was the scale used ($r \leq .10$). However, when using the “grossed-out” scale, the more intense a participant rated PROP to taste the more “grossed-out” they were by all transgressions; $r = .27, p < .01$.

Newman-Keuls post hoc comparisons on the priming scale by gender interaction showed that women gave higher ratings on the “angry” scale than men did (M -female = $7.04 \pm SEM = 0.16$, M -male = $6.45 \pm SEM = 0.20$), but there were no gender differences with the “grossed-out” scale (M -female = $6.37 \pm SEM = 0.19$, M -male = $6.29 \pm SEM = 0.23$).

Figure 2 illustrates the priming scale by moral-type interaction. Newman-Keuls comparisons showed that for nonvisceral and implied-visceral transgressions, participants gave higher scores on

the “angry” than “grossed-out” scale, and there was no difference between “angry” ratings for these two transgressions types. When using the “grossed-out” scale, ratings increased significantly between nonvisceral and implied-visceral transgressions. Visceral transgressions received the highest ratings overall with no difference between scales.

Based on the pilot study results showing that the BSQ sexual vignettes were rated as more morally wrong than nonsexual visceral vignettes, an ANCOVA with PROP taste sensitivity (gLMS score) as the covariate, gender as the between-subjects variable, visceral type (sexual, nonsexual), and priming scale (“angry,” “grossed-out”) as within subjects factors was also conducted. Main effects of gender, $F(1, 99) = 5.33, p < .05, h^2 = 0.05$, and visceral type, $F(1, 99) = 3.87, p = .05, h^2 = 0.04$, were obtained. Women gave more negative ratings on both scales than men did (M -female = $8.45 \pm SEM = 0.13$, M -male = $7.93 \pm SEM = 0.16$), and sexual visceral vignettes were rated more negatively ($M = 8.45 \pm SEM = 0.11$) than nonsexual vignettes ($M = 7.97 \pm$

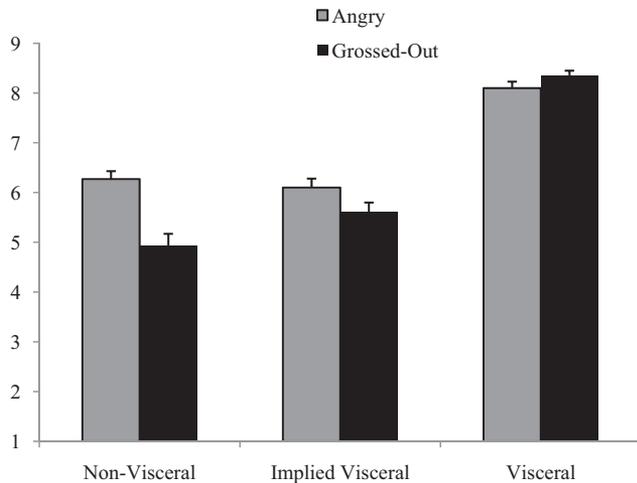


Figure 2. Mean ratings on The “Angry” and “Grossed-Out” Scales (\pm SEM) as a function of moral transgression type. Mean ratings for the three types of moral violations (nonvisceral, implied-visceral, visceral) by rating scale; “angry” (1 = *not at all angry* to 9 = *extremely angry*), “grossed-out” (1 = *not at all grossed-out* to 9 = *extremely grossed-out*). Comparing scales, for *nonvisceral* and *implied-visceral* violations, “angry” ratings were significantly higher than “grossed-out” ratings; for *visceral* ratings, “angry” and “grossed-out” ratings did not differ. Comparing across moral transgression type, “angry” ratings were equivalent for *nonvisceral* and *implied-visceral* violations but statistically higher for *visceral* violations; with the “grossed-out” scale, ratings increased statistically as the transgression type became more viscerally involving.

$SEM = 0.13$). No interactions were revealed, and no main effects of taste sensitivity or priming scale were found (e.g., M -“angry” = $8.02 \pm SEM = 0.14$, M -“grossed-out” = $8.36 \pm SEM = 0.11$).

Discussion

Hypothesis 1, Replication of Past Results

As hypothesized, the previous finding that PROP taste sensitivity is related to visceral disgust sensitivity, but not moral disgust sensitivity, was supported. The greater a participant’s sensitivity to PROP the more reactive they were to core and pathogen visceral disgust elicitors (DS and TDDS-pathogen subscale), but their taste sensitivity had no bearing on their disgust sensitivity to moral violations of autonomy (TDDS-moral subscale). These findings add further support for the proposition that the “disgust” response to moral and visceral elicitors is not the same, and that visceral disgust has its basis in taste reactivity, but moral disgust does not (Herz, 2011).

Hypothesis 2, the Relationship Between Taste Sensitivity and Different Types of Moral Disgust

It was hypothesized that if all moral transgressions activate the same disgust response then the substrate for this reactivity (taste sensitivity) should be equivalently (un)related to all types of moral transgressions. However, if responses to moral violations only relate to taste sensitivity when visceral disgust is additionally experienced, then responses to autonomy violations should be

unrelated to taste sensitivity, and responses to moral transgressions that include a visceral component should reflect taste sensitivity to corresponding degrees.

Hypothesis 2 was not supported in so much as it was not found that an individual’s taste sensitivity was related to increased reactivity to moral transgressions as a function of the transgression’s visceral involvement. However, an interesting and unexpected set of results were obtained. When participants used the “angry” scale to evaluate the various moral transgressions no relationship between taste sensitivity and moral type emerged, suggesting that there is an equivalent emotional basis to all forms of moral disgust which is independent of taste sensitivity. However, when using the “grossed-out” scale, taste sensitivity directly affected ratings toward *all* transgression types. The more sensitive an individual was to PROP the more “grossed-out” they were by all the transgressions, regardless of their visceral nature (see Hypothesis 3, Part A).

The three transgression types were clearly different from each other. Visceral transgressions were rated as worst on both priming scales followed by implied-visceral and then nonvisceral transgressions, regardless of participants’ taste sensitivity. Nevertheless, verbal priming of the language of disgust was able to elicit overall sensitivity to all moral transgressions as a function of an individual’s taste sensitivity. It is unclear why the visceral quality of a transgression did not interact with taste sensitivity and enhance responding accordingly. One possibility is that the effects of somatic priming superseded any differences between items. This issue should be explored in future research.

Hypothesis 3, Somatic Verbal Priming Induces Moral Disgust

It was hypothesized that if somatic effects are primed by exposure to the term “grossed-out” then the underlying taste connection to visceral disgust should be activated leading to: (a) a relationship between individual taste sensitivity and responding with the “grossed-out” scale, and (b) all moral violations becoming more viscerally disgusting in the context of this term. By contrast no such effects were expected in the context of priming with the alternate negative emotion term “angry.”

Part A of Hypothesis 3 was supported. Consistent with Damasio’s *somatic marker hypothesis* (Damasio, 1994), when participants used the “grossed-out” scale, the greater an individual’s taste sensitivity the more intensely they responded. That is, “grossed-out” primed emotional reactivity as a function of how taste sensitive the participant was. Further supporting Hypothesis 3 (Part A), no relationship between taste sensitivity and priming with “angry” was observed, indicating that the somatic state elicited by “angry” is not related to the taste underpinnings of emotional disgust. Furthermore, with the “angry” scale nonvisceral and implied-visceral transgressions were evaluated equivalently suggesting that as we and others have found “angry” is more related to moral condemnation than “grossed-out” is (Gutierrez et al., 2012; Herz & Hinds, 2013; Hutcherson & Gross, 2011; Nabi, 2002).

These findings suggest that specific language can transform a moral transgression into a viscerally repulsive event, and the degree to which this occurs correlates with an individual’s sensitivity to the oral origins of visceral disgust—avoidance of bitter taste. The ability of words to prime somatic emotional states with direct psychological consequences is supported by other recent

research in morality (Feroni & Semin, 2009; Lee & Schwartz, 2010; Wheatley & Haidt, 2005). Importantly, however, somatic priming does not appear to be a uniform response and instead depends on underlying individual differences in relation to the emotional state that is primed. Investigating how various individual difference factors modulate somatic priming of specific emotions would be of great interest now, as would be examining whether priming of one emotion first (e.g., anger) influences subsequent priming effects for different emotional states (e.g., disgust).

Part B of Hypothesis 3, that all moral violations would become more viscerally disgusting in the context of the “grossed out” was not supported. However, it was found that the more visceral a transgression was the more “gross” it was perceived to be. This validates the distinction made between the categories of moral transgressions in the present experiment, and is consistent with prior research examining the term “grossed-out” in relation to visceral repulsion (Gutierrez et al., 2012; Hutcherson & Gross, 2011; Nabi, 2002).

Sexual disgust is often described as visceral (e.g., Royzman, Leeman, & Sabini, 2008); however, the oral-visceral connection was not found on the TDDS-sexual subscale here. A plausible explanation may be that, depending on one’s personal biases, items such as “watching a pornographic video” could be considered a moral rather than a sexual transgression. Olatunji et al. (2012) also noted some specific underlying commonalities between the TDDS sexual and moral subscales. Furthermore, no taste sensitivity connection was found for the sexual items on the BSQ, even though sexual visceral violations were rated as more morally wrong and elicited more negative affect overall (both anger and grossed-out) than nonsexual visceral violations. Taken together this suggests that sexual disgust may not be visceral in the same way that core and pathogen disgusts are, and supports prior research that sexual disgust represents a unique class of disgust elicitors (Borg, Lieberman, & Kiehl, 2008; Parkinson et al., 2011; Tybur et al., 2009). Continued investigation into the differences between the different domains of disgust will be an important avenue of future research.

Hypothesis 4, Gender Differences

It was hypothesized that women would show greater disgust sensitivity and moral condemnation overall than men would.

Hypothesis 4 was generally supported except for the results of the DS test. Contrary to prior findings using the original (Haidt et al., 1994) and current version of the DS test (e.g., Herz, 2011), no gender differences were observed on the DS in the present study. Women gave slightly higher ratings than men did, but there was a high degree of variability in the responses of both men and women and the difference was not statistically reliable. Notably, we recently found a similar lack of statistically reliable gender differences in another study using this same scale (Herz & Hinds, 2013). This shortened version of the DS may therefore not be optimal for capturing gender differences. Women, however, did score reliably higher than men on the TDDS-pathogen and sexual subscales, which is consistent with prior research from my laboratory and others (Herz, 2011; Tybur, Bryan, Lieberman, Caldwell-Hopper, & Merriman, 2011). Interestingly, although women were much more sensitive to items on the TDDS-sexual subscale than men were, they did not rate the sexual visceral items on the BSQ differently than men did. Women gave more negative ratings toward the visceral items than men did as a whole, but men and

women equivalently rated sexual transgressions more negatively than non-sexual transgressions. Women were also not more condemning toward the moral transgressions overall than men were, except when using the “angry” scale. Notably, both men and women gave higher ratings on the “angry” scale regardless of the transgression type, suggesting that all participants focused predominantly on the moral aspect of the violation. This supports other studies showing that the dominant emotion elicited by moral violations is anger (Herz & Hinds, 2013; Nabi, 2002; Olatunji et al., 2012; Rozin, Lowery, Imada, & Haidt 1999). The gender difference observed for “angry” on the BSQ may be explained by women being more condemning of moral violations in general (Whitley, Bichlmeier-Nelson, & Jones, 1999), which supports the present hypothesis.

Only one other study has examined individual differences in reactivity to specific emotions as a function of PROP taste sensitivity. Macht and Mueller (2007) found that supertasters had more intense anger responses to watching a rape scene from the movie *Pretty Woman* than did tasters and nontasters. However, sadness from watching a death scene in *The Champ* did not differ by taster status. The authors proposed that heightened taste sensitivity may correspond with heightened emotional arousal, which occurs in the emotion of anger but not sadness. Disgust and other arousing emotions, such as fear and joy, were not assessed in their experiment. The results from the present study, however, suggest that it is not the arousingness of the emotion that underlies the connection to taste sensitivity, but rather the viscerally disturbing nature of the elicitor (rape or rot). Arousal was not directly measured here or by Macht and Mueller (2007) and major methodological differences exist between the present study and theirs, therefore, further research directly investigating the relationship between emotional arousal and PROP taste sensitivity is needed.

In sum, the present results support past research that sensitivity to visceral disgust elicitors is related to taste sensitivity but that sensitivity to moral disgust elicitors is not (Herz, 2011). Importantly, however, the current results for the first time show that when the language of visceral disgust is primed (“grossed-out”) taste sensitivity becomes a mediator of moral disgust such that individuals with greater taste sensitivity become especially susceptible to visceral somatic priming of disgust. Thus, linguistic priming can transform a moral transgression into a viscerally repulsive event and susceptibility to this priming varies as a function of an individual’s sensitivity to the oral origins of visceral disgust—bitter taste.

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Appendix

Transgression Vignettes in the Behavioral Situations Questionnaire

Nonvisceral

A scientist must report positive findings to receive further grant money but her recent data are inconclusive, so she fabricates results to receive more funding.

A classmate has the answer key for the next exam and is selling the answers.

While attempting to parallel park in front of the gym a man hits another car crumpling their front bumper, so he quickly pulls away making sure no one has seen him and parks somewhere else.

A bank manager steals a pearl necklace when she is at the mall.

Implied-Visceral

A family’s dog was killed by a car in front of their house so the family cremates the dog and then sprinkles the remains in a sandbox where the neighborhood children play.

A woman leaves work unwrapping a sandwich she has brought for lunch. As she is about to bite into the sandwich she notices that part of the bread is moldy so she gives it to a homeless man who is asking for spare change.

While driving to work a man sees a bad car crash and there are no emergency personnel around. He stares at the wreckage and keeps on driving.

Mr. Smith catches his colleague stealing money from his desk. The thief threatens Mr. Smith with a box cutter and takes the money.

Visceral Sexual

A man and his 14-year-old daughter frequently have sex.

An attractive young woman has just died and two boys who have always admired her dig up her body and have sex with it.

Visceral Nonsexual

A geneticist decides to clone some human leg cells and uses her own leg as a first try. To her surprise the cells grow into a piece of flesh that looks like a steak; curious she decides to grill it for a dinner party and serves it to friends who don’t know what they are eating.

A drug company discovers that a newly developed product can cause serious birth defects if taken during pregnancy. The company releases the drug anyway and when dozens of deformed infants are born they deny any claims of the associated dangers.

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