



Exposed intestines and contaminated cooks: Sex, stress, & satiation predict disgust sensitivity

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ABSTRACT

An evolutionary perspective predicts that the intensity of the disgust response should depend on the ancestral costs and benefits of coming into contact with disease vectors. Previous research advanced the compensatory behavioral prophylaxis hypothesis: progesterone-induced immunosuppression should be accompanied by increased disgust and contaminant-avoidance. However, extant data do not address whether factors other than progesterone-induced immunosuppression also trigger heightened disgust. The current study delineates two competing prophylaxis hypotheses and adjudicates between them by testing whether stress and satiation, which shift the costs and benefits of prophylactic behavior but are unrelated to progesterone-induced immunosuppression, predict disgust sensitivity. Results revealed a sex–stress–satiation interaction in predicting Disgust Scale-Revised (DS-R) scores. This study provides evidence of a broader system of compensatory prophylaxis, illuminates the functional basis of facultative shifts in disgust, and presents conceptual and statistical analyses for more cleanly cleaving the psychology of disgust at its natural joints.

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1. Introduction

Disgust is a regulatory emotion that motivates disease avoidance and reduces the likelihood of parasitic, bacterial, and viral infection (Curtis, Aunger, & Rabie, 2004; Oaten, Stevenson, & Case, 2009). Disgust is a component of the *behavioral immune system*, a suite of mechanisms that detects cues to pathogen presence and triggers functionally coordinated cognitive and affective responses that motivate behavioral avoidance of disease agents (Duncan, Schaller, & Park, 2009; Neuberg, Kenrick, & Schaller, 2011).

Despite the universality of the emotion of disgust (Curtis & Biran, 2001; Ekman, 1993; Ekman & Friesen, 1971), there are pronounced individual differences in *disgust sensitivity*—the extent to which pathogen cues activate cognitive and affective mechanisms motivating avoidance behaviors (e.g. de Jong & Merckelbach, 1998; Haidt, McCauley, & Rozin, 1994). Recent research has advanced our understanding of the proximate causes and ultimate functions of disgust (e.g. Neuberg et al., 2011; Schaller, Miller, Gervais, Yager, & Chen, 2010), but the ultimate causes of individual and contextual variation in disgust remain poorly understood. This paper applies an evolutionary framework to enhance our understanding of the functional nature of this emotion and individual variation in its expression.

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An evolutionary perspective predicts that disgust sensitivity should depend on the costs and benefits of avoiding potential disease agents recurrent in ancestral environments. That is, disgust should be more strongly activated under conditions recurrently associated with higher net fitness costs of coming into contact with contaminants. Previous theorists have advanced the compensatory behavioral prophylaxis hypothesis, positing that progesterone-induced decreases in immune functioning during pregnancy and across the ovulatory cycle should be accompanied by increases in disgust and behavioral avoidance of contaminants (Fessler, Eng, & Navarrete, 2005; Fleischman & Fessler, 2011). Fessler and colleagues (2005) found that women experience heightened disgust during the first trimester of pregnancy, when immunosuppression is most pronounced. Research has also shown that women in the luteal phase of the ovulatory cycle – when progesterone levels and immunosuppression are highest – experience increased disgust and heightened prophylactic behavior (Fleischman & Fessler, 2011).

This work illuminates the functional nature of disgust and the behavioral immune system, but leaves important questions unanswered. First, extant data do not address whether compensatory prophylaxis can be triggered by causes of immunosuppression other than reproductive immunomodulation. Moreover, it remains unknown whether variables unrelated to immune functioning, but that influence the costs and benefits of prophylactic behavior, also lead to facultative shifts in disgust.

The current paper outlines competing compensatory behavioral prophylaxis hypotheses, and derives and tests discriminative

predictions from these two hypotheses. Hypothesis 1 – the *narrow behavioral prophylaxis hypothesis* – proposes that compensatory behavioral prophylaxis is limited to reproductive immunomodulation, or immunosuppression triggered by heightened progesterone. By contrast, hypothesis 2 – the *broad behavioral prophylaxis hypothesis* – proposes a broader system of prophylaxis that is activated by a wider range of cues to increased costs of pathogen-exposure. This range of cues may encompass immunosuppression caused by reproductive immunomodulation, immunosuppression unrelated to reproduction, and contexts unrelated to immune functioning that would have shifted the costs and benefits of prophylactic behaviors in ancestral environments.

We advance the broad behavioral prophylaxis hypothesis because natural selection should have favored prophylactic mechanisms whose activation was sensitive to *any* conditions recurrently associated with incurring costs or reaping benefits from disease avoidance behaviors. This paper examines two variables that would be expected to influence compensatory prophylaxis mechanisms under the broad (but not the narrow) prophylaxis hypothesis: stress and satiation.

1.1. Stress

Elevated stress, which suppresses immune functioning, should be directly associated with heightened disgust sensitivity. Stress increases disease susceptibility in a variety of species, including humans (Cohen & Williamson, 1991; Glaser & Kiecolt-Glaser, 2005; Herbert & Cohen, 1993). This is true for a range of stressors, from financial stress to relationship difficulties (Arnetz et al., 1987; Kiecolt-Glaser & Glaser, 1992), and for a range of diseases (e.g. colds, herpes, and mononucleosis; VanderPlate, Aral, & Magder, 1988). Stress-mediated immunosuppression would have shifted the costs of disease-avoidance behavior during hominid evolution: failure to avoid contaminants would have been more costly for stressed individuals. The broad (but not the narrow) hypothesis thus yields the prediction that an individual's stress levels should be positively associated with disgust sensitivity.

1.2. Satiation

Satiation should also predict disgust sensitivity under the broad prophylaxis hypothesis. The costs of consuming potentially contaminated food would have been equivalent for hungry and sated individuals. Hungry individuals, however, would have reaped greater benefit from eating potentially contaminated, but also potentially nutritious, sustenance-providing foods. The broad (but not the narrow) hypothesis thus predicts that hungry individuals should exhibit lower disgust sensitivity than sated individuals.

1.3. Sex

Research has revealed a robust sex difference in disgust sensitivity: women have higher mean levels of disgust sensitivity than men (e.g. Curtis et al., 2004; Haidt et al., 1994). This finding is consistent with both hypotheses, and thus cannot offer discriminative support in favor of either one. For example, the classical sex difference in disgust could be due to heightened compensatory prophylaxis triggered by progesterone-induced immunosuppression, as women on average have higher levels of progesterone than men (NIH Clinical Center, 2012). An alternative explanation for this sex difference is that natural selection favored higher disgust sensitivity among women because they spent more time in close contact with their offspring in ancestral conditions than did men (Sear & Mace, 2008). This would have meant that, on average, women would have faced a higher risk of transmitting pathogens to their offspring or fetuses. Pathogen exposure would thus have had

greater fitness repercussions for women than for men. These two possibilities, the first derived from the narrow compensatory prophylaxis hypothesis and the second derived from the broad hypothesis, are not mutually exclusive. Because the finding of women's higher disgust sensitivity does not discriminate between these potential explanations, the effect of sex on disgust sensitivity cannot adjudicate between the competing hypotheses presented in this paper. Nonetheless, in keeping with previous research, we predicted that women would exhibit higher disgust sensitivity.

2. Method

2.1. Participants

We recruited four hundred twenty-eight women and 155 men, (ages 18–70, $M = 24.9$, $SD = 7.8$) from the community at-large and introductory psychology courses at a public university in the southwestern United States. Participants provided informed consent, and those enrolled in introductory psychology received partial course credit.

2.2. Questionnaire and procedure

As part of a larger study, participants completed a questionnaire consisting of items for which we had *a priori* predictions (e.g. stress, satiation) and the Disgust Scale-Revised (DS-R; Haidt et al., 1994, modified by Olatunji et al., 2007). Because lengthier scales may have induced fatigue effects, we used single items to assess stress and satiation. Recent research has demonstrated that single-item measures have similar reliabilities as, strong convergent correlations with, and explain nearly as much variance as longer scales (Yarkoni, 2010). Together with these concerns about fatigue effects, the specific, immunomodulation-based nature of our hypotheses led us to focus our investigation on pathogen-disgust, and rendered disgust related to anti-incestuous sentiment and morality beyond the scope of the current study (Tybur, Lieberman, & Griskevicius, 2009).

The stress and satiation questions asked, “How stressed do you feel right now?” and “How full (satiated) do you feel right now?” Participants responded to these items on 7-point Likert-type scales ranging from 1 (not full at all, very hungry) to 7 (completely full) and 1 (not stressed at all) to 7 (extremely stressed). The DS-R is a 25-item measure of disgust. Each question is measured on a 5-point scale, and after reverse scoring three items, all items are summed to compute a composite disgust score (Olatunji et al., 2007).

Participants completed the questionnaire on the Qualtrics server. Upon completion, participants were debriefed and thanked for their participation.

3. Results

3.1. Disgust components

The original Disgust Scale (DS) proposed eight different domains of disgust but exhibited an unstable factor structure and unsatisfactory reliability (Haidt et al., 1994; Olatunji et al., 2007). Subsequent analyses have produced several revisions (Olatunji et al., 2007). The three-factor DS-R is currently the most widely used, but the DS-R's factor structure remains questionable.

The DS-R divides disgust into three factors: *core*, *contamination-based*, and *animal-reminder*. Core disgust is described as “disgust based on a sense of offensiveness and the threat of disease.” Contamination disgust is defined as “disgust reactions based on the perceived threat of transmission of contagion.” The third factor,

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