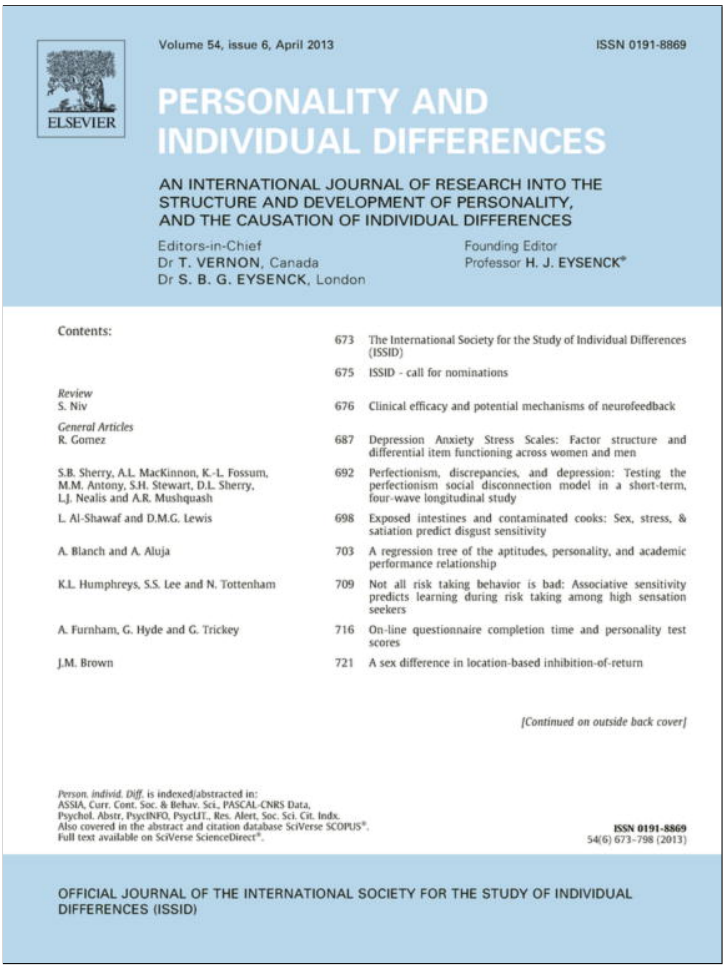

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Exposed intestines and contaminated cooks: Sex, stress, & satiation predict disgust sensitivity

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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.

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.

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

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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,

animal reminder disgust, is described as "disgust that reflects the aversion of stimuli that serve as reminders of the animal origins of humans" (Olatunji et al., 2007, p. 285).

From an evolutionary perspective, the domains of disgust presented by the current DS-R model do not cleave human psychology at its natural joints, leaving it with potential conceptual and theoretical shortcomings. The overlap between core disgust – "a sense of offensiveness and the threat of disease" – and contamination disgust – "based on the perceived threat of transmission of contagion" – leaves their distinguishing features unclear. Indeed, recent research has demonstrated that these subscales are highly correlated and do not demonstrate distinctiveness (Tybur et al., 2009). Moreover, the animal reminder factor is difficult to reconcile with an evolutionary perspective on the emotions. Unlike threats of contagious disease, reminders of humans' animal origins would not have negatively impacted human survival or reproduction during hominid evolution. As such, animal reminder is not a conceptually tenable subcategory of disgust (for a different discussion of this problem, see Tybur et al., 2009).

To arrive at components of disgust that cleave human psychology at its natural joints, we performed a Principal Components Analysis (PCA; direct oblimin rotation) on the 25 items of the DS-R. We initially extracted all components with an eigenvalue greater than 1. This yielded six components, but the scree plot indicated a smaller number. We subsequently compared all models composed of five or fewer components. To identify the best model, we employed the criterion of minimizing the total number of items that either (a) failed to have an absolute loading of at least .35 on one component or (b) had absolute loadings equal to or greater than .35 on more than one component. This analysis converged on two distinct components (between-component $r = -.408$; Table 1).

Component 1, *Contamination*, included items such as "I probably would not go to my favorite restaurant if I found out that the cook had a cold". Component 2, *Death & Dismemberment*, included items such as "You see a man with his intestines exposed after an accident." Component loadings for all 25 items are presented in Table 1. Both components exhibited satisfactory reliability (Contamination: $\alpha = .77$, Death & Dismemberment: $\alpha = .80$).

This two-component model has two advantages over the three-factor DS-R. First, unlike animal-reminder disgust, Contamination and Death & Dismemberment represent conceptually viable subcategories of disgust. Second, Contamination and Death & Dismemberment are distinct subcategories, unlike the DS-R's subscales. *Contamination* is pathogen-based, and corresponding to this domain of adaptive problems, its items describe contagion from other humans, bodily effluvia, personal hygiene, and unsafe food sources. *Death & Dismemberment*, on the other hand, describes issues related to physical trauma, and is concerned with injury and the particular disease threats posed by this class of stimuli. Correspondingly, its items describe signs of severed body parts, disembowelment, and death.

Despite overlap, these two domains of disgust are functionally distinct. In ancestral environments, they would have been caused by different categories of events, each associated with qualitatively different classes of cues that may have triggered distinct behavioral responses. In particular, the *Death & Dismemberment* domain represents a class of stimuli that would have been indicative of the risk of physical injury or attack, but also of pathogen exposure. As such, this domain may elicit a negative emotional response that contains elements of both fear and disgust.

3.2. Statistical analysis

We conducted backward elimination regression analyses to explore the main effects of, and interactions between, stress, sex, and satiation. Overall DS-R scores and the Contamination and Death & Dismemberment component scores were entered as dependent variables in separate multiple regression analyses.

The three-way interaction between sex, stress, and satiation predicted DS-R scores, $\beta = .79$, $t(537) = 2.00$, $p < .05$ (see Table 2 for full regression model). Simple slopes tests indicated that stress increased disgust sensitivity among both hungry men, $t = 3.46$, $p = .001$, and sated women, $t = 2.35$, $p = .02$ (Fig. 1). The effect of

Table 1
Factor loadings of Disgust Scale (DS-R) items.

Item	Contamination	Death & Dismemberment
You take a sip of soda, and then realize that you drank from the glass that an acquaintance of yours had been drinking from	***.64***	.15
I never let any part of my body touch the toilet seat in public restrooms	***.63***	.16
While you are walking through a tunnel under a railroad track, you smell urine	***.60***	−.15
Even if I was hungry, I would not drink a bowl of my favorite soup if it had been stirred by a used but thoroughly washed flyswatter	***.57***	.06
You discover that a friend of yours changes underwear only once a week	***.56***	−.08
I probably would not go to my favorite restaurant if I found out that the cook had a cold	***.55***	.08
A friend offers you a piece of chocolate shaped like dog doo	***.53***	−.01
As part of a sex education class, you are required to inflate a new unlubricated condom using your mouth	***.52***	−.04
You are about to drink a glass of milk when you smell that it is spoiled	***.49***	−.04
You are walking barefoot on concrete, and you step on an earthworm	***.47***	−.21
I might be willing to try eating monkey meat, under some circumstances	***−.39***	.09
You see someone put ketchup on vanilla ice cream, and eat it	***.36***	−.21
It bothers me to hear someone clear a throat full of mucus	.27	−.11
It would bother me tremendously to touch a dead body	−.07	***−.81***
You see a man with his intestines exposed after an accident	−.06	***−.71***
It would bother me to be in a science class, and to see a human hand preserved in a jar	−.07	***−.66***
It would not upset me at all to watch a person with a glass eye take the eye out of the socket	.19	***.58***
You accidentally touch the ashes of a person who has been cremated	.25	***−.52***
Your friend's pet cat dies, and you have to pick up the dead body with your bare hands	.30	***−.50***
It would bother me to sleep in a nice hotel room if I knew that a man had died of a heart attack in that room the night before	.14	***−.49***
I will go out of my way to avoid walking through a graveyard	.20	***−.43***
You see maggots on a piece of meat in an outdoor garbage pail	.30	***−.42***
If I see someone vomit, it makes me sick to my stomach	.07	***−.37***
It would bother me to see a rat run across my path in a park	.31	***−.35***
Seeing a cockroach in someone else's house doesn't bother me	−.23	.23

Factor loadings ⩾.35 italicized and bolded.

Table 2
Regression models predicting disgust sensitivity as a function of stress, sex, and satiation.

DS-R scores	*B*	*SE*	*β*
Individual differences			
Stress	.21*	.09	.54
Sex	1.51***	.36	1.09
Satiation	.13*	.06	.35
Two-way interactions			
Stress × Sex	−.27**	.10	−.92
Stress × Satiation	−.02	.02	−.37
Sex × Satiation	−.24**	.08	−.96
Three-way interaction			
Sex × Stress × Satiation	.04*	.02	.79
Contamination			
Individual differences			
Sex	.55**	.17	.38
Satiation	.05	.03	.12
Two-way interactions			
Sex × Satiation	−.08*	.04	−.32
Death & Dismemberment			
Individual differences			
Stress	.14**	.04	.27
Sex	1.09***	.27	.61
Satiation	.07	.04	.16
Two-way interactions			
Stress × Sex	−.10*	.05	−.26
Sex × Satiation	−.12**	.04	−.38

* $p < .05$.
** $p < .01$.
*** $p < .001$.

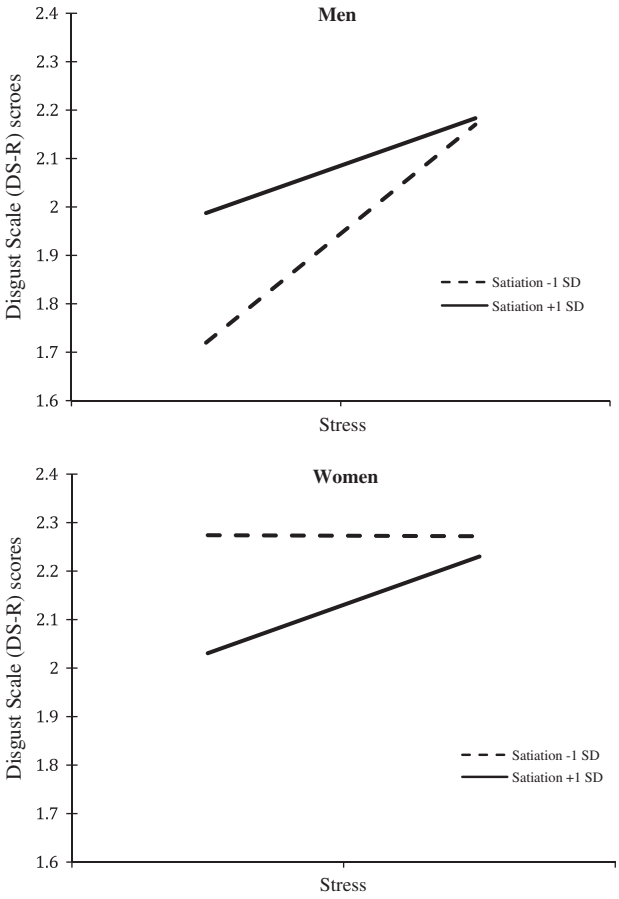

Fig. 1. Three-way interaction between sex, stress, and satiation in predicting composite Disgust Scale (DS-R) scores. Lines represent model-predicted disgust sensitivity levels. Higher levels of stress predicted greater disgust sensitivity among men (top), an effect that did not differ as a function of satiation level. Higher levels of stress were also associated with greater disgust sensitivity among women, but this effect was limited to sated women (bottom). Consistent with the three predicted main effects, model-predicted disgust levels were lowest for hungry, low-stress men.

stress among sated men did not reach statistical significance, $t = 1.21$, *ns*. However, the effect was in the predicted direction for sated men, and simple slopes difference tests indicated that the effect of stress did not differ between sated men and hungry men ($t = -.84$, $p = .40$) or between sated men and sated women ($t = .04$, $p = .97$). There was no effect of stress on hungry women, $t = -.04$, $p = .97$. Consistent with the three predicted main effects, the disgust levels of low-stress, low-satiation men were lower than for any other individuals (Fig. 1).

Our *a priori* hypotheses pertained to composite disgust scores, but we conducted exploratory multiple regression analyses on the distinct disgust components as well. We found that different models predicted disgust sensitivity in these two domains.

Sex and satiation interacted to predict Contamination disgust, $\beta = -.32$, $t(537) = -2.25$, $p < .05$ (see Table 2 for full regression model). Satiation was more positively associated with Contamination among men than among women. The final regression model for Death & Dismemberment included two two-way interactions. Satiation and sex interacted to predict Death & Dismemberment disgust, $\beta = -.38$, $t(537) = -2.71$, $p < .01$. Stress and sex also interacted to predict sensitivity to Death & Dismemberment cues, $\beta = -.26$, $t(537) = -1.98$, $p < .05$.

3.3. Disgust Scale

The fact that different final models predicted the two components is consistent with the notion that these components may reflect distinct domains of disgust. To further explore the structure of these underlying constructs, and to contribute to the continued refinement of the DS-R, we conducted exploratory factor analyses (method: ML; rotation: direct oblimin) using the same convergence criteria employed for the PCA. This analysis converged on a two-factor solution (between-factor $r = -.522$) that was virtually identical to that of the PCA. All items loaded on the same factors, with the exception of three: "You see maggots on a piece of meat on an outdoor garbage pail," "If I see someone vomit, it makes me sick to my stomach," and "It would bother me to see a rat run across my path in a park." These three items had higher loadings on the two EFA factors relative to their loadings on the PCA components. The remaining 22 items loaded on the same factors as they did in the principal components analysis.

4. Discussion

The current study's results replicate the finding that women have higher mean levels of disgust than do men. Results provide discriminative support for the broad behavioral prophylaxis hypothesis: stress and satiation influence disgust sensitivity despite being unrelated to progesterone fluctuations or reproductive immunomodulation. These findings begin to address previously unanswered questions about the scope of compensatory prophylaxis, and contribute to our understanding of facultative shifts in disgust sensitivity. Finally, we propose a new factor structure for the DS-R, buttressed by three pieces of evidence: evolutionary theoretical considerations, factor analysis results, and regression findings indicating distinct predictive models for the two domains.

We predicted main effects of stress, sex, and satiation on disgust sensitivity, but discovered a more complex relationship. As

predicted, increased stress was associated with increased disgust among men and sated women. The relationship between stress and disgust is thus consistent with the notion that stress's immunosuppressive effect leads to a compensatory increase in behavioral prophylaxis and lends support to the broad behavioral prophylaxis hypothesis. However, it remains an open question why the effect of stress was absent among hungry women. One possible interpretation is that hungry women, who have very high baseline levels of disgust in our dataset, may incur prohibitively high costs from further increases in disgust, as this would lead to excessive avoidance of potential food sources. One potential explanation for the unexpected finding that hungry women have higher levels of disgust than sated women is that hunger levels and food intake are positively correlated with progesterone levels (Czaja, 1975; Dalvit, 1981; Hervey & Hervey, 1967), and some evidence suggests a causal relationship between heightened progesterone and increased hunger (Roberts, Kenney, & Mook, 1972).

5. Limitations and future directions

Recent research has demonstrated that single-item measures often exhibit comparable reliability and validity to those of longer scales (Yarkoni, 2010). Nonetheless, future work should replicate these findings with longer stress and satiation scales, including measures of chronic stress. It is important to expand disgust stimuli to include images or other cues of high ecological validity (Curtis et al., 2004; Fleischman & Fessler, 2011), and to replicate the findings reported in this article using the Disgust Scale developed by Tybur et al. (2009). It would also be fruitful to incorporate endocrinological measures of stress and satiation (e.g. hormones such as cortisol, leptin, orexin, and ghrelin), and immune markers such as CD4 and CD8 T-cell counts. Finally, future work should investigate the manifest behavioral output of the disgust system in response to cues from distinct domains of adaptive problems (Neuberg et al., 2011).

6. Conclusions

This study makes several contributions to the literature on disgust sensitivity. First, it proposes a novel hypothesis about the nature and scope of disgust, and by advancing and testing two competing evolutionary hypotheses, it provides discriminative support for the broad behavioral prophylaxis system. Second, our theoretical and statistical analyses offer a factor structure that is as empirically sound and more conceptually compelling than the current DS-R, which hopefully will contribute to the continued refinement of the Disgust Scale (Haidt et al., 1994; Olatunji et al., 2007) Third, using an evolutionary biological theoretical framework, this study identified stress and satiation as previously unexamined variables that predict facultative shifts in disgust.

In finding support for a broader system of compensatory prophylaxis, this study calls attention to a host of previously uninvestigated variables (e.g. sleep deprivation, depression) that may be linked to disgust sensitivity via their association with immunosuppression, or via their influence on the costs and benefits of prophylactic behavior. We hope that this framework will be of heuristic value in spurring new research and guiding researchers to important variables that may have otherwise remained unexamined.

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References

Arnetz, B. B., Wasserman, J., Petrini, B., Brenner, S. O., Levi, L., Eneroth, P., et al. (1987). Immune function in unemployed women. *Psychosomatic Medicine, 49*(1), 3–12.

Cohen, S., & Williamson, G. (1991). Stress and infectious disease in humans. *Psychological Bulletin, 109*, 5–24. http://dx.doi.org/10.1037/0033-2909.109.1.5.

Curtis, V. A., Aunger, R., & Rabie, T. (2004). Evidence that disgust evolved to protect from risk of disease. *Proceedings of the Royal Society B: Biological Sciences, 271*, 131–133. http://dx.doi.org/10.1098/rsbl.2003.0144.

Curtis, V. A., & Biran, A. (2001). Dirt, disgust and disease: Is hygiene in our genes? *Perspectives in Biology and Medicine, 44*, 17–31. http://dx.doi.org/10.1353/pbm.2001.0001.

Czaja, J. A. (1975). Food rejection by female rhesus monkeys during the menstrual cycle and early pregnancy. *Physiology & Behavior, 14*, 579–587.

Dalvit, S. P. (1981). The effect of the menstrual cycle on patterns of food intake. *The American Journal of Clinical Nutrition, 34*(9), 1811. Retrieved from <http://www.ajcn.org/content/34/9/1811.short>.

de Jong, P. J., & Merckelbach, H. (1998). Blood-injection-injury phobia and fear of spiders: Domain specific individual differences in disgust sensitivity. *Personality and Individual Differences, 24*, 153–158. http://dx.doi.org/10.1016/S0191-8869(97)00178-5.

Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: Development and validation of a 15-item self-report instrument. *Personality and Individual Differences, 47*, 541–546. http://dx.doi.org/10.1016/j.paid.2009.05.001.

Ekman, P. (1993). Facial expression and emotion. *American Psychologist, 48*(4), 384–392. http://dx.doi.org/10.1037/0003-066X.48.4.384.

Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology, 17*(2), 124–129. http://dx.doi.org/10.1037/h0030377.

Fessler, D. M. T., Eng, S. J., & Navarrete, C. D. (2005). Elevated disgust sensitivity in the first trimester: Evidence supporting the compensatory prophylaxis hypothesis. *Evolution and Human Behavior, 26*(4), 344–351. http://dx.doi.org/10.1016/j.evolhumbehav.2004.12.001.

Fleischman, D. S., & Fessler, D. M. T. (2011). Progesterone's effects on the psychology of disease avoidance: Support for the compensatory behavioral prophylaxis hypothesis. *Hormones and Behavior, 59*, 271–275. http://dx.doi.org/10.1016/j.yhbeh.2010.11.014.

Glaser, R., & Kiecolt-Glaser, J. K. (2005). Stress-induced immune dysfunction: Implications for health. *Nature Reviews Immunology, 5*(3), 234–251. http://dx.doi.org/10.1038/nri1571.

Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences, 16*(5), 701–713. http://dx.doi.org/10.1016/0191-8869(94)90212-7.

Herbert, T. B., & Cohen, S. (1993). Stress and immunity in humans: A meta-analytic review. *Psychosomatic Medicine, 55*, 364–379.

Hervey, E., & Hervey, G. R. (1967). The effects of progesterone on body weight and composition in the rat. *Journal of Endocrinology, 37*, 361–384. http://dx.doi.org/10.1677/joe.0.0370361.

Kiecolt-Glaser, J. K., & Glaser, R. (1992). Psychoneuroimmunology: Can psychological interventions modulate immunity? *Journal of Consulting and Clinical Psychology, 60*, 569–575. http://dx.doi.org/10.1037/0022-006X.60.4.569.

Neuberg, S. L., Kenrick, D. T., & Schaller, M. (2011). Human threat management systems: Self-protection and disease avoidance. *Neuroscience Biobehavioral Review, 35*(4), 1042–1051. http://dx.doi.org/10.1016/j.neubiorev.2010.08.011.

NIH Clinical Center. (2012). Progesterone historical reference ranges. *United States National Institutes of Health.* <http://cclnprod.cc.nih.gov/dlm/testguide.nsf/Index> Retrieved 17.01.12.

Oaten, M., Stevenson, R. J., & Case, T. I. (2009). Disgust as a disease-avoidance mechanism. *Psychological Bulletin, 135*, 303–321. http://dx.doi.org/10.1037/a0014823.

Olatunji, B. O., Williams, N. L., Tolin, D. F., Abramowitz, J. S., Sawchuk, C. N., Lohr, J. M., et al. (2007). The disgust scale: Item analysis, factor structure, and suggestions for refinement. *Psychological Assessment, 19*(3), 281–297. http://dx.doi.org/10.1037/1040-3590.19.3.281.

Roberts, S., Kenney, N. J., & Mook, D. G. (1972). Overeating induced by progesterone in the ovariectomized, adrenalectomized rat. *Hormones and Behavior, 3*, 267–276. http://dx.doi.org/10.1016/0018-506X(72)90040-2.

Schaller, M., Miller, G. E., Gervais, W. M., Yager, S., & Chen, E. (2010). Mere visual perception of other people's disease symptoms facilitates a more aggressive immune response. *Psychological Science, 21*, 649–652. http://dx.doi.org/10.1177/0956797610368064.

Sear, R., & Mace, R. (2008). Who keeps children alive? A review of the effects of kin on child survival. *Evolution and Human Behavior, 29*, 1–18. http://dx.doi.org/10.1016/j/evolhumbehav.2007.10.001.

Tybur, J. M., Lieberman, D., & Griskevicius, V. (2009). Microbes, mating, and morality: Individual differences in three functional domains of disgust. *Journal of Personality and Social Psychology, 97*, 103–122. http://dx.doi.org/10.1037/a0015474.

VanderPlate, C., Aral, S. O., & Magder, L. (1988). The relationship among genital herpes simplex virus, stress, and social support. *Health Psychology, 7*(2), 159–168. http://dx.doi.org/10.1037/0278-6133.7.2.159.

Yarkoni, T. (2010). The abbreviation of personality, or how to measure 200 personality scales with 200 items. *Journal of Research in Personality, 44*(2), 180–198. http://dx.doi.org/10.1016/j.jrp. 2010.01.002.