Microbes, Mating, and Morality: Individual Differences in Three Functional Domains of Disgust

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What is the function of disgust? Whereas traditional models have suggested that disgust serves to protect the self or neutralize reminders of our animal nature, an evolutionary perspective suggests that disgust functions to solve 3 qualitatively different adaptive problems related to pathogen avoidance, mate choice, and social interaction. The authors investigated this 3-domain model of disgust across 4 studies and examined how sensitivity to these functional domains relates to individual differences in other psychological constructs. Consistent with their predictions, factor analyses demonstrated that disgust sensitivity partitions into domains related to pathogens, sexuality, and morality. Further, sensitivity to the 3 domains showed predictable differentiation based on sex, perceived vulnerability to disease, psychopathic tendencies, and Big 5 personality traits. In exploring these 3 domains of disgust, the authors introduce a new measure of disgust sensitivity. Appreciation of the functional heterogeneity of disgust has important implications for research on individual differences in disgust sensitivity, emotion, clinical impairments, and neuroscience.

Keywords: disgust, individual differences, emotions, evolutionary psychology

Disgust is a heterogeneous emotion, elicited in response to a variety of acts and substances ranging from feces and vomit to incest and pornography to lying and stealing. The varied nature of disgust raises questions of how best to characterize the emotion's function and, of particular interest here, how to investigate patterns of individual differences in how the emotion is experienced.

Whereas previous models have suggested that disgust motivates avoidance to serve more general functions (e.g., protecting the self; S. B. Miller, 2004), we draw on an adaptationist perspective and propose that selection has favored the evolution of three functionally specialized domains: *pathogen disgust*, which motivates the avoidance of infectious microorganisms; *sexual disgust*, which motivates the avoidance of sexual partners and behaviors that would jeopardize one's long-term reproductive success; and *moral disgust*, which motivates the avoidance of social norm violators. We use this theoretical perspective to generate and test hypotheses related to individual differences in disgust sensitivity and to suggest that an improved understanding of disgust has significant implications for multiple areas of psychological research.

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A Brief History of Disgust

Emotion researchers have long recognized disgust as one of the basic human emotions (Darwin, 1872/1965; Plutchik, 1962; Tomkins & McCarter, 1964). Disgust has a culturally universal facial expression (Ekman & Friesen, 1975) and a signature physiological response including nausea and vomiting (Rozin & Fallon, 1987), increased salivation (Angyal, 1941), and activation of the autonomic nervous system (Ekman, Levenson, & Friesen, 1983; R. W. Levenson, Ekman, & Friesen, 1990; Zajonc & McIntosh, 1992). Theories of the function of disgust have traditionally focused on the oral rejection of harmful or distasteful substances (Ekman & Friesen, 1975; Rozin & Fallon, 1987; Tomkins, 1963). For example, Darwin (1872/1965) defined disgust as referring to "something revolting, primarily in relation to the sense of taste, as actually perceived or vividly imagined; and secondarily to anything which causes a similar feeling, through the sense of smell, touch, and even of eyesight" (p. 250). Similarly, Angyal (1941), in another early consideration of disgust, proposed that disgust is

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directed against the threat of ingesting certain substances, including bodily wastes of humans and other animals.

The recognition that disgust applies to objects and acts beyond food (e.g., dead bodies, incest, moral transgressions) has led some theorists to suggest that the emotion serves a more general function of protecting and maintaining the self (e.g., S. B. Miller, 2004), whereas others have posited an expansion of the function of disgust into multiple distinct domains. Chief among the proposed models of disgust has been the model advanced by Rozin and colleagues (Haidt, McCauley, & Rozin, 1994; Haidt, Rozin, McCauley, & Imada, 1997; Rozin & Fallon, 1987; Rozin, Haidt, & McCauley, 2000; Rozin, Lowery, & Ebert, 1994; Rozin, Millman, & Nemeroff, 1986). After examining the varied elicitors of disgust, Rozin et al. (2000) concluded that the emotion functions in four separate domains: (a) core disgust, which functions to protect the body from contamination and is elicited by certain foods, animals, and body products; (b) animal reminder disgust, which functions to protect the soul by preventing people from recognizing their animal nature—and thus their mortality—and is elicited by sex, bad hygiene, death, and body envelope violations (i.e., acts that involve punctured skin or objects entering the body); (c) interpersonal disgust, which functions to protect the soul and social order and is elicited by contact with undesirable others; and (d) moral disgust, which also functions to protect the social order and is elicited by moral offenses.

On the basis of this model of disgust, Haidt et al. (1994) developed the Disgust Scale as a measure of individual differences in disgust sensitivity. The Disgust Scale was intended to assay individual differences across core disgust and animal reminder disgust, plus sensitivity to acts thought to capture two laws of magical thinking: (a) the law of contagion (i.e., the notion that contact communicates properties between substances) and (b) the law of similarity (i.e., the notion that perceptually similar objects possess similar attributes; see Rozin et al., 1986). To date, the Disgust Scale has been used in more than 100 published articles spanning diverse areas of research, including studies of social stigma (Smith, Loewenstein, Rozin, Sherriff, & Ubel, 2007), phobias (Olatunji, Williams, Sawchuk, & Lohr, 2006), obsessive–compulsive disorder (Berle & Philips, 2006; Woody & Tolin, 2002), gender roles (Charash, McCay, & Dipaolo, 2006), ethnocentrism (Navarrete & Fessler, 2006), attitudes toward body image and the self (Burris & Rempel, 2004; Fessler & Haley, 2006), religiosity (Olatunji, Tolin, Huppert, & Lohr, 2005), homophobia (Olatunji, 2008), and eating disorders (Troop, Murphy, Bramon, & Treasure, 2000; Troop, Treasure, & Serpell, 2002). However, a number of theoretical and measurement issues limit the utility of this conception of individual differences in disgust sensitivity.

Problems With Past Conceptualizations and Measurements of Disgust Sensitivity

Although the perspective suggested by Rozin and colleagues (Haidt et al., 1994, 1997; Rozin & Fallon, 1987; Rozin et al., 1986, 1994, 2000) effectively highlights the varied nature of disgust, there remain a number of important theoretical and measurement issues that have yet to be addressed. A first issue relates to the proposed domain of animal reminder disgust. According to Rozin and colleagues, humans feel disgust toward features that remind us of our animal nature because such features threaten to make us feel "lowered, debased, and (perhaps most critically) mortal" (Rozin et al., 2000, p. 642). Drawing from work by E. Becker (1973) and terror management theory (Goldenberg, Pyszczynski, Greenberg, & Solomon, 2000), Rozin et al. (2000) further suggested, "disgust can be understood as a defense against a universal fear of death" (p. 643). This perspective can be questioned on multiple fronts. First, from an evolutionary perspective, the survival value of an anti-animal reminder mechanism is questionable (see Fessler & Navarrete, 2005; Kirkpatrick & Navarrete, 2006). Second, assuming the universal fear of death characterized by terror management theory even exists, it is unclear how a disgust response would alleviate such a fear or neutralize a reminder of humanity's membership within the animal kingdom. Disgust does not seem well engineered to perform this function. Third, the existence of an animal reminder domain composed of disgust toward sexuality, death, envelope violations, and hygiene has never been demonstrated empirically; indeed, these four categories are characterized as separate, modestly correlated domains on the Disgust Scale. Finally, some have suggested that there is not much evidence that people even avoid reminders that they are animals (Bloom, 2004; Fessler & Navarrete, 2005; Royzman & Sabini, 2001). For example, many English phrases indicate that humans often appreciate comparisons to animals (e.g., "cool cat," "strong as an ox," "brave as a lion," "gentle as a dove," "wise as an owl"), and people do not seem disgusted by or avoidant of many behaviors that both humans and nonhuman animals engage in, including sleeping, breathing, jumping, and walking. In fact, people readily blur the line between humans and nonhumans by inviting pets into their families as honorary kin. In sum, the theoretical, empirical, and practical support for a distinct animal reminder domain of disgust is tenuous.

A second issue concerns the conceptual distinctiveness of the domains proposed by Rozin et al. (2000). The majority of disgust elicitors bundled into these domains appear to be parsimoniously explained as sources of disease. Although core disgust is suggested to function to protect against disease, disgust responses toward many disease risks are categorized into other domains. For example, disgust toward corpses, flesh wounds, and individuals with poor hygiene—all sources of infection—are considered elicitors of animal reminder disgust. Further, disgust toward undesirable strangers, who may also carry communicable diseases, is categorized as interpersonal disgust. Thus, it is not clear that these putative domains are necessarily conceptually distinct.

These issues have important ramifications for the model of individual differences introduced by Haidt et al. (1994). In developing the Disgust Scale, Haidt et al. (1994) first asked people to generate a list of disgust elicitors. Although the researchers suggested the existence of four disgust domains (e.g., Rozin et al., 2000), they qualitatively categorized disgust elicitors into eight different categories without clear theoretical justification: offensive food substances, animals, body products, death, body envelope violations, inappropriate sexual behavior, bad hygiene, and moral offenses. When quantitative analyses revealed that the items concerning moral offenses did not covary with the others, the moral domain was omitted from the measure. In place of the moral domain, the researchers added their own items relating to the laws of magical thinking, ultimately yielding the 32-item Disgust Scale. Although the researchers began scale development with the goal of creating a multidimensional measure of disgust sensitivity, the

eight qualitatively derived subdomains demonstrated low internal reliability (alphas ranging from .34 to .60, with an average of .48) and were thus deemed "not high enough for interpretation of individual patterns of subscale scores" (Haidt et al., 1994, p. 711). In aggregate, however, the 32-item measure demonstrated good internal reliability ($\alpha = .81$), and Haidt et al. (1994) concluded that the Disgust Scale is best conceptualized as a measure of general sensitivity to disgust rather than a robust, multidimensional measure. Despite this, the subdomains are often treated as if they were empirically and theoretically distinct (e.g., Calder, Keane, Manes, Antoun, & Young, 2000; Goldenberg et al., 2001; Rozin, Taylor, Ross, Bennett, & Heimadi, 2005; Troop et al., 2002).

A recent revision of the Disgust Scale (Olatunji et al., 2007) found that the four items measuring reactions to sexual behaviors did not covary with the other seven subdomains, and the sexual domain was subsequently removed. Although disgust is clearly elicited by moral transgressions and by certain types of sexual acts, the original Disgust Scale allows only limited inquiry into the sexual sphere,[1] whereas the Disgust Scale—Revised (Disgust Scale-R; Olatunji et al., 2007) ignores both sexuality and morality altogether. Thus, there currently is no way of measuring individual differences across the more varied set of disgust elicitors. In light of these conceptual and measurement issues, we sought to reexamine disgust by looking at its underlying function(s) from an adaptationist perspective.

An Adaptationist View of Disgust

Psychologists who take an adaptationist approach generate testable hypotheses regarding human cognition and behavior by considering the selection pressures that recurred over evolutionary history (Andrews, Gangestad, & Matthews, 2002; Buss, Haselton, Shackelford, Bleske, & Wakefield, 1998; Tooby & Cosmides, 1992). This theoretical framework has proven useful in a variety of research areas, including mate choice (Bleske-Rechek & Buss, 2006; Gangestad, Garver-Apgar, Simpson, & Cousins, 2007), aggression (Griskevicius et al., 2009), person perception (D. V. Becker, Kenrick, Neuberg, Blackwell, & Smith, 2007; Cottrell, Neuberg, & Li, 2007), kin-directed behaviors such as altruism and sexual avoidance (Ackerman, Kenrick, & Schaller, 2007; Burnstein, Crandall, & Kitayama, 1994; Lieberman, Tooby, & Cosmides, 2003, 2007), perceptual biases (Haselton & Funder, 2006; Maner et al., 2005), social stigma (Kurzban & Leary, 2001; Neuberg, Smith, & Asher, 2000; Schaller & Neuberg, 2008), cultural variability (Fincher, Thornhill, Murray, & Schaller, 2008; Gangestad, Haselton, & Buss, 2006; Schaller & Murray, 2008), and behaviors ranging from conformity (Griskevicius, Goldstein, Mortensen, Cialdini, & Kenrick, 2006) to consumer spending (Griskevicius et al., 2007; G. F. Miller, Tybur, & Jordan, 2007). Importantly, the adaptationist perspective has also proven useful in the study of emotions (see Cosmides & Tooby, 2000; Keltner, Haidt, & Shiota, 2006; Ohman & Mineka, 2001; Pinker, 1997). Given the cross-cultural universality of disgust (Ekman, 1972) and its role in domains related to survival (e.g., disease avoidance) and reproduction (e.g., sexual behaviors), an adaptationist perspective is highly appropriate for studying the emotion.

We propose that, rather than serving abstract functions related to protecting the soul or avoiding reminders of our animal nature, disgust evolved to motivate behavioral solutions to multiple distinct adaptive problems: avoiding substances associated with disease-causing agents in ancestral environments (Curtis, Aunger, & Rabie, 2004; Curtis & Biran, 2001; Fessler, Eng, & Navarrete, 2005; Haidt et al., 1997), avoiding sexual partners and behaviors that would reduce one's long-term reproductive success (Fessler & Navarrete, 2003, 2004), and avoiding individuals who inflict social costs on oneself or members of one's social network (see Levine & Kurzban, 2006). We briefly discuss each of the proposed adaptive functions of disgust in turn.

Pathogen Disgust

Infectious microorganisms were a recurring feature of human ancestral environments and posed a constant threat to survival and reproduction (Maynard Smith, 1978; Tooby, 1982). For this reason, selection would have favored mechanisms that protected against the fitness costs associated with infectious agents. In addition to a complex and robust physiological immune system that functions to attack pathogens in the event they enter the body (Delves, Martin, Burton, & Roitt, 2006), selection also engineered pathogen disgust, a first line of defense that functions as a "behavioral immune system" preventing contact with and ingestion of pathogens (Schaller, 2006; Schaller & Duncan, 2007).

That disgust is related to pathogens is, of course, not a novel idea (e.g., see Angyal, 1941; Haidt et al., 1997; Rozin & Fallon, 1987). However, in line with other researchers, we posit that pathogen disgust evolved specifically to serve the function of pathogen avoidance (Curtis et al., 2004; Curtis & Biran, 2001; Fessler & Navarrete, 2003; Marzillier & Davey, 2004; Pinker, 1997). Pathogen disgust is elicited by objects likely to contain infectious agents, including dead bodies, rotting foods, and bodily fluids such as feces, phlegm, vomit, blood, and semen, and it motivates proximal avoidance of such things. Pathogen disgust is also elicited by stimuli emitting the same visual, olfactory, tactile, or auditory cues that reliably indicated pathogen presence in our ancestral past, even when an item possessing such cues may be devoid of infectious agents (e.g., plastic imitation vomit or fudge shaped to look like feces; Rozin et al., 1986).

In sum, pathogens constituted an intense selection pressure, leading to the evolution of information processing systems designed to detect infectious microorganisms and motivate their avoidance. Revisiting the multiple categories of disgust elicitors suggested by Haidt et al. (1994), it is evident that they capture a variety of sources of disease-causing agents. For instance, foods, animals, and body products—core disgust elicitors—are all potentially infectious. Similarly, three of the four elicitors of animal reminder disgust (dead bodies, individuals with poor hygiene, and body envelope violations) are also sources of contagion—even objectively noninfectious objects conceptualized within the animal

[1] The sexual items in the Disgust Scale have questionable construct validity. For example, two of the four items measuring sexual disgust ask participants to note true or false to items involving moral judgments: "I think homosexual activities are immoral" and "I think it is immoral for people to seek sexual pleasure from animals." The strength of the relation between moral judgment of homosexuality and bestiality and disgust toward those acts has not been established, leaving it uncertain whether these items measure a disgust response.

reminder domain (e.g., amputated limbs, congenital deformities) elicit a disease-avoidance response (Haselton & Nettle, 2006; Kurzban & Leary, 2001; Park, Faulkner, & Schaller, 2003; Schaller & Duncan, 2007). What were originally viewed as independent categories of disgust elicitors are more parsimoniously explained as related disgust elicitors within a broader domain of pathogen disgust. Sex, however, the fourth elicitor of animal reminder disgust, does not exclusively pertain to proximate pathogen avoidance. Rather, it addresses a separate adaptive problem: avoiding sexual partners and behaviors imposing net reproductive costs.

Sexual Disgust

The relationship between sexuality and disgust has long been recognized (e.g., Angyal, 1941). For instance, disgust has been identified as a reaction to unwanted sexual contact (Tomkins, 1963), as the antithesis of sexual arousal (Koukounas & McCabe, 1997; Vonderheide & Mosher, 1988), and as the prototypical response when individuals are asked to imagine sex with close genetic relatives (Ackerman et al., 2007; Fessler & Navarrete, 2004; Haidt, 2001; Lieberman et al., 2007; Westermarck, 1891/1921). Indeed, sexual acts are a specific category of disgust elicitors under the model of disgust proposed by Rozin and colleagues (e.g., Haidt et al., 1994). However, in contrast to the animal reminder perspective, which suggests that sexual disgust evolved to protect us from recognizing that we are animals (Goldenberg et al., 2000, 2001; Haidt et al., 1994; Rozin et al., 2000), we suggest that sexual disgust is an evolved solution to the adaptive problem of avoiding biologically costly mates and sexual behaviors (see also Fessler & Navarrete, 2003).

Over evolutionary history, one's choice of sexual partners and behaviors carried significant reproductive consequences because individuals varied in qualities impacting offspring survival and reproduction. Whereas certain sexual partners increased the probability of producing multiple, healthy offspring, others potentially jeopardized one's reproductive success. Given this selection pressure, natural selection likely favored mechanisms that were able to evaluate potential partners along dimensions relevant to reproductive success and systems that motivated pursuit (e.g., lust) or avoidance (e.g., disgust) accordingly.

Importantly, potential sexual partners can vary in quality along two broad dimensions: intrinsic quality and genetic compatibility (Jennions & Petrie, 2000; Neff & Pitcher, 2005). A mate's intrinsic quality is reflected in features that influence objective physical attractiveness, regardless of genetic compatibility. Such features include body symmetry, facial attractiveness, and body shape—dimensions that men and women use to assess attractiveness (e.g., Grammer, Fink, Møller, & Thornhill, 2003; Singh, 1993; Thornhill & Gangestad, 1993, 2006).

Genetic compatibility affects mate suitability in a more relative manner. A potential partner's genetic similarity to oneself—rather than intrinsically low genetic quality—can reduce reproductive success. Compatibility can be influenced by factors such as major histocompatibility complex similarity (Penn & Potts, 1999) and genetic relatedness. For instance, though one's close kin (e.g., siblings, parents, offspring) might possess many attributes desirable in a mate (e.g., have high intrinsic mate quality), they are not suitable mating partners because close inbreeding increases the probability of producing less healthy offspring (Bittles & Neel, 1994; Charlesworth & Charlesworth, 1999; Haig, 1999).

Individuals displaying cues for low intrinsic quality or low compatibility are likely to be poor mate choices and should thus be avoided as sexual partners. Disgust is an emotion well suited to perform this function (Lieberman, 2006). The disgust that motivates sexual avoidance, however, is distinct from the disgust motivating pathogen avoidance, not only with respect to the sets of information required to assess mate suitability versus infection risk, but also in regards to the nature of the optimal avoidance behaviors. Whereas pathogen detection relies on cues such as pus and foul odor, the assessment of mate suitability depends on a host of other cues described above—many of which are not relevant to proximal pathogen avoidance (e.g., seeing one's mother care for a newborn, a cue to siblingship; Lieberman et al., 2007). Further, whereas individuals and objects displaying cues of communicable infection should motivate general avoidance, an individual deemed an unsuitable mating partner should motivate avoidance specifically within the context of mating, leaving open the possibility for other categories of social interactions (e.g., nepotism, friendship, social exchange, or group membership).

In sum, avoiding sexual partners and behaviors potentially jeopardizing one's reproductive success constitutes a separate adaptive problem from pathogen avoidance and requires different systems for assessing the risks associated with sex. Sexual disgust, we argue, is specifically well suited to perform the function of avoiding reproductively costly sexual behaviors, narrowing the pool of sexual behaviors and partners to those likely to contribute to the production of healthy viable offspring.

Moral Disgust

A third domain of disgust pertains to social transgressions. When asked to generate a list of things that disgust them, people often report antisocial behaviors alongside items and acts that we would categorize as elicitors of pathogen or sexual disgust (Haidt et al., 1994; Nabi, 2002). These social transgressions broadly include nonnormative, often antisocial activities such as lying, cheating, and stealing that harm others directly and/or impose diffuse costs on one's social group. For example, a sample of Australian psychology students who read vignettes about crimes involving drug trafficking, conning, fraud, or theft were more likely than control participants to form disgust words in a word-stem completion task (Jones & Fitness, 2008). This association between such antisocial behaviors and disgust is not exclusive to Western, English-speaking cultures. Haidt et al. (1997) reported that, when asked to generate a list of disgust elicitors, a Hebrew-speaking woman from Israel cited politicians, a Japanese-speaking student from Hiroshima cited verbal abuse, and an English-speaking student from Chicago cited child abuse.

However, some have argued that the term disgust is used to describe social transgressions merely for greater rhetorical effect and that actual responses to such acts may not be related to disgust at all (e.g., Bloom, 2004; Nabi, 2002). This hypothesis can be tested by examining whether pathogen-related acts and common socio-moral violations such as lying, cheating, and stealing activate common neural regions associated with the emotion disgust. Recent functional magnetic resonance imaging (fMRI) investigations show they do (Moll et al., 2005; Schaich

Borg, Lieberman, & Kiehl, 2008). For instance, in Schaich Borg et al. (2008), conjunction analyses revealed that pathogen-related acts, incestuous acts, and socio-moral violations all activate a network of brain regions previously reported to be associated with disgust (e.g., the globis pallidus, putamen, caudate head, and amygdala). Behavioral studies also indicate disgust is linked with moral judgments (e.g., Marzillier & Davey, 2004; Wheatley & Haidt, 2005), further suggesting that disgust is not just used metaphorically or rhetorically to describe social transgressions, but instead reflects a response toward multiple elicitors including infection, incest, and iniquity.

From an evolutionary perspective, avoiding interactions with other individuals who imposed costs on oneself or on members of one's social network would have been beneficial. Within the social arena, other individuals are capable of inflicting costs in a number of ways; in addition to lying, cheating, and stealing, group members can injure, kill, rape, free ride, denigrate, and cuckold. Such behaviors inflict costs directly, and they can disrupt cooperative relationships, social networks, and group cohesion (Cottrell & Neuberg, 2005). Individuals capable of avoiding those whose actions regularly registered as large net costs would have fared better than those who did not discriminate along this dimension.

In addition to being elicited by different cues than pathogen and sexual disgust, moral disgust motivates a different behavioral strategy. Whereas pathogen disgust motivates proximal avoidance of perceived infection risks and sexual disgust motivates avoidance of individuals within the specific context of sexual interactions, moral disgust motivates avoidance of social relationships with norm-violating individuals. As recent research indicates, moral disgust might also underlie motivations to punish norm-violating third parties (e.g., Kurzban, DeScioli, & O'Brien, 2007).

Overview of Current Studies

An adaptationist perspective predicts the existence of three functional domains of disgust, each of which addresses a unique set of adaptive problems. This organization is distinct from previous conceptions and has direct implications for studying individual differences in disgust sensitivity. As mentioned previously, we suspect that the measure developed by Haidt et al. (1994) largely measures sensitivity to pathogen disgust but does not adequately consider individual differences in sexual or moral disgust. Indeed, there is currently no measure of disgust that captures the functional heterogeneity of this emotion. Here we aim to fill this gap.

Across four studies, we investigate individual differences in sensitivity to pathogen, sexual, and moral disgust. Studies 1 and 2 use factor analytic techniques to see if a wide array of disgust elicitors categorize into these domains. Both studies establish that a wide array of disgust elicitors can be empirically categorized into domains of pathogen, sexual, and moral disgust and that systematic sex differences exist across domains in a manner consistent with our framework. In Study 2, we further provide evidence for discriminant and convergent validation in relation to other personality constructs. Specifically we examine the relationship between pathogen, sexual, and moral disgust and psychopathy, perceived vulnerability to disease, and the Big Five personality traits, each of which is predicted to relate to specific disgust domains. Study 3 uses confirmatory factor analysis (CFA) to see if the factor structure observed in Studies 1 and 2 replicates in a more diverse, nonuniversity sample. Finally, Study 4 introduces the Three-Domain Disgust Scale and uses structural regression analyses to contrast our three-domain measure with that developed by Haidt et al. (1994) and modified by Olatunji et al. (2007).

Study 1

The first study investigated the factor structure of disgust responses to a wide range of potentially disgusting objects, behaviors, and situations. Based on our theoretical model, we predicted that individual differences would covary along three dimensions reflecting sensitivity to pathogen, sexual, and moral disgust. The first study also tested a theoretically derived prediction concerning domain-specific sex differences in disgust sensitivity.

Previous research has found that women are generally more sensitive to disgust than men (Curtis et al., 2004; Druschel & Sherman, 1999; Haidt et al., 1994). Based on our theoretical model, however, we predicted that sex differences in disgust sensitivity should vary across domains. Specifically, we predicted that the largest sex difference would be found in the sexual domain. This prediction stems from a consideration of the different costs associated with sexual reproduction for men and women (Trivers, 1972). Whereas sex for men generally does not preclude immediate future reproductive success, sex for women potentially does, given women's 9-month gestation period and subsequent lactation commitment. Also, sexual activities place women at greater risk for sexually transmitted diseases (Varghese, Maher, Peterman, Branson, & Steketee, 2001) and reputational damage than men (Buss, 1989; Dickemann, 1981). Because women paid such higher costs for poor sexual choices across evolutionary history, they should thus be much more avoidant of (and hence more disgusted by) a variety of sexual behaviors. Consistent with this prediction, women are on average much less open than men to short-term sex (Gangestad & Simpson, 2000) and sex with strangers (Clark & Hatfield, 1989), whose intrinsic quality and compatibility may be difficult to assess at first glance. In line with previous findings, we also predicted a moderate sex difference in pathogen disgust but did not expect this difference to be as robust as the sex difference for sexual disgust, given that men and women faced more similar selection pressures regarding pathogens. Also, given similar selection pressure between the sexes, we did not expect strong sex difference in the moral domain.

Method

Participants and procedures. One-hundred-sixty undergraduate psychology students (109 women, 51 men) at a major university completed a paper-and-pencil survey in exchange for course credit. Participant age ($M = 21.69$ years, $SD = 3.68$) was typical for this type of sample.

Measures. We modeled our item-generation procedures after the methods described by Haidt et al. (1994) in their generation of the original Disgust Scale. Specifically, we asked a group of 14 individuals (4 undergraduate students, 5 graduate students, and 5 psychology professors) to each list up to 15 things they found disgusting. This group was composed of individuals that varied in sex, ethnicity, and age, and all of the individuals were blind to our hypotheses. To gather a sufficient pool of items to test our hy-

potheses, we asked that the nominated items reflect a variety of acts that people might consider "disgusting" in any way, including issues related to sexuality and morality. In total, 105 items were generated. We examined the nominated items and eliminated ones that were redundant (e.g., multiple people selecting "poop"; items related to feces or vomit were nominated by nearly every individual), too extreme to yield meaningful variation on a self-report measure (e.g., "drinking vomit," "swallowing someone else's blood"), or too specialized to the individuals who nominated the items (e.g., local locations and political figures). This careful process of elimination led us to eliminate 47 of the nominated items, leaving a total of 58 items to be included in Study 1.

The items covered a wide range of topics, including domains that would be categorized under the Rozin et al. (2000) model as core disgust (e.g., "seeing mold on some leftovers in your refrigerator"), interpersonal disgust (e.g., "touching a stranger's feet"), and each elicitor of animal reminder disgust, including sex (e.g., "hearing two strangers having sex"), death (e.g., "touching a dead body"), envelope violations (e.g., "seeing someone's bone sticking out of their leg"), and hygiene (e.g., "standing next to someone on the bus who has strong body odor"). Items also included theft (e.g., "stealing from a neighbor"), specific sexual acts (e.g., "having anal sex with someone of the opposite sex"), dishonesty (e.g., "a student cheating to get good grades"), promiscuity (e.g., "bringing someone you just met back to your room to have sex knowing you will never see them again"), nonreciprocity (e.g., "a member of a work group choosing not to contribute anything but sharing equally in all the benefits"), and sexual partner choice (e.g., "an opposite-sex stranger intentionally rubbing your thigh in an elevator"). Participants were asked to rate the degree to which they felt each item was disgusting on a 7-point Likert-type scale with anchors labeled *not disgusting at all* (0) and *extremely disgusting* (6).

Despite the presence of multiple acts mapping onto multiple domains proposed by Rozin et al. (2000; e.g., core disgust, animal reminder disgust, and interpersonal disgust), we predicted the emergence of three factors that mapped onto pathogen disgust, sexual disgust, and moral disgust.

Results

Factor structure of disgust sensitivity. We conducted all analyses for Studies 1 and 2 using SPSS 14.0. We identified covarying groups of items using factor analysis. Because factor analytic results can be distorted by violations of normality among individual items (Tabachnick & Fidell, 2007), 10 items with skewness or kurtosis that exceeded |2| were excluded from the analysis.[2] A principal-axis factor analysis was conducted on the remaining 48 items. The Kaiser–Meyer–Olkin measure of sampling adequacy was .84, indicating that the individual items shared a sufficient amount of common variance for such an analysis.

The first 10 eigenvalues were 11.29, 4.92, 2.59, 1.98, 1.64, 1.61, 1.53, 1.33, 1.28, and 1.22. We used two criteria to determine how many factors to extract: a visual scree test (Cattell, 1966), which involves examining the scree plot for the point at which a line drawn through eigenvalues changes slope, and a parallel analysis (Horn, 1965), which involves comparing observed eigenvalues to those obtained from factor analyses on several samples of random data of the same number of variables and cases as the observed data. The number of observed eigenvalues exceeding the 95th percentile of simulated eigenvalues is taken as the appropriate number of factors to extract. To conduct the parallel analyses, we used procedures developed by O'Connor (2000) and ran 5,000 simulations of sets of random data with 160 cases and 48 variables. Only the top 3 eigenvalues from our factor analysis were greater than the 95th percentile of the eigenvalues from the random simulation, suggesting that three factors be extracted. However, the visual scree test was unclear; it suggested that either three or four factors be extracted. In the event that the number of factors to be extracted is unclear, it is appropriate to extract and rotate multiple solutions and examine item loadings to determine which solution is most appropriate (Gorsuch, 1983).

Accordingly, we first extracted and rotated four factors using direct oblimin criteria to allow for correlated factors. The first three factors were readily interpretable, appearing to reflect moral disgust (the three highest loading items being "stealing bank account information online," "forging another person's signature on a legal document," and "a mechanic overcharging elderly people"), pathogen disgust (the three highest loading items being "stepping in a large pile of dog poop," "sitting next to someone with open red sores on their arm," and "accidentally touching someone's bloody cut"), and sexual disgust (the three highest loading items being "bringing someone back to your room to have sex, knowing you will never see them again," "watching pornography," and "hearing two strangers having sex"). However, the fourth factor did not appear to be conceptually cohesive: only one item loaded on it above .5 ("having sex with someone with Down's syndrome"), one other item loaded on it above .4 ("seeing someone's bone sticking out of their leg"), and two other items loaded on it above .3 ("being hit on by an attractive individual of the same sex" and "seeing a 25-year-old man and a 65-year-old woman out on a date").

A three-factor solution was then rotated using direct oblimin criteria, and the factor structure appeared to straightforwardly reflect sensitivity to pathogen, sexual, and moral disgust. The pattern matrix indicated that only 2 of the 48 items failed to load at least .3 on any of the three factors. The remaining 46 items loaded at least .3 on one and only one factor. Importantly, item loadings were consistent with the predicted three-factor structure: The first factor was related to pathogen disgust, the second factor was related to sexual disgust, and the third factor was related to moral disgust (see Table 1 for items and factor loadings). Given that the interpretation of these three factors was consistent across both three-factor and four-factor extractions, and the four-factor solution included a theoretically ambiguous factor with diffuse item loadings, we proceeded with a three-factor extraction. The pathogen factor was correlated with the sex factor ($r = .41$) and the moral factor ($r = .30$), and the sex and moral factors were

[2] Notably, items related to incestuous acts (e.g., hearing about an adult brother and sister who like having sex with each other) were among the 10 excluded due to extreme nonnormality. Although such items are hypothesized to elicit specifically sexual disgust, the extreme, nearly universal disgust reactions to such items render them poor candidates for measurement of individual differences on a self-report measure (see Lieberman et al., 2007, for a discussion of individual differences in attitudes toward incest).

Table 1
Items and Factor Loadings for Studies 1 and 2

Item	Pathogen		Sexual		Moral	
	Study 1	Study 2	Study 1	Study 2	Study 1	Study 2
Accidentally touching someone's bloody cut	**.71**	**.63**	−.09	−.13	.04	.03
Sitting next to someone with open red sores on their arm	**.70**	**.48**	−.23	.03	.08	.19
Shaking hands with a stranger who has sweaty palms	**.66**	**.57**	−.06	.08	.08	−.03
Stepping in a large pile of dog poop	**.66**	**.45**	.05	.01	−.02	.13
Standing next to someone on the bus who has strong body odor	**.58**	**.58**	.02	−.02	−.03	.16
Seeing mold on some leftovers in your refrigerator	**.58**	**.43**	−.03	.11	−.03	.09
Seeing someone pick their nose	**.52**	.23	.17	.24	−.02	.25
Finding a hair in your food	**.47**	.36	.12	.11	−.04	.31
Seeing someone's bone sticking out of their leg	**.45**	**.53**	−.01	−.03	.04	−.13
Touching a stranger's feet	**.42**	**.48**	.15	.12	.11	.02
Eating a cracker that has fallen on the ground outside	**.40**	.36	.15	.16	.17	.18
Seeing a 25-year-old man and a 65-year-old woman out on a date	**.40**	.33	.11	.33	.19	−.04
Touching a dead body	.37	**.49**	.05	.16	−.01	−.11
Kissing someone you find physically unattractive	.35	**.42**	.20	.04	−.06	−.02
Smelling that the milk you are about to drink is slightly spoiled	.35	.39	.08	.13	−.03	.04
Having sex with someone with Down's syndrome	.32	**.48**	−.07	−.04	.01	−.04
Hearing someone vomit	.29	.31	.13	.29	−.17	.03
Bringing someone you just met back to your room to have sex knowing you will never see them again	−.10	−.02	**.80**	**.61**	.10	.09
Watching pornography	.00	−.09	**.64**	**.82**	−.04	.00
An opposite-sex stranger touching your thigh in an elevator	−.03	−.06	**.57**	**.41**	.03	.14
Hearing two strangers having sex	.16	.01	**.53**	**.67**	−.08	.04
Walking into a changing room and accidentally seeing someone your age of the opposite sex naked	.06	−.03	**.52**	**.60**	.17	−.05
Having anal sex with someone of the opposite sex	.12	.04	**.49**	**.57**	−.05	−.01
Having sex in exchange for money	.03	.11	**.48**	**.42**	.20	.33
Finding out that someone you don't like has sexual fantasies about you	.20	.19	**.45**	**.41**	.14	.02
Going to a nude beach	.21	−.01	**.42**	**.73**	.13	−.05
You having sex with a person 30 years older than you	.39	.27	.16	.39	.07	.03
Having sex with your sweaty partner after they worked out for an hour	.32	.24	.10	**.43**	.20	−.15
Having sex while you (or your partner) have their period	.35	.16	.17	.35	.05	−.03
A woman terminating her pregnancy	.01	.03	.04	**.42**	.32	.10
Being hit on by an attractive individual of the same sex	.18	.12	.28	.28	.11	−.05
Stealing bank account information online	−.16	.08	−.03	−.12	**.91**	**.71**
Forging another person's signature on a legal document	−.08	−.05	−.06	.20	**.83**	**.59**
A mechanic overcharging elderly people	−.04	.14	.00	−.22	**.82**	**.72**
Cutting to the front of the line to purchase the last four tickets of a show	−.07	−.12	.02	−.02	**.78**	**.47**
A student cheating to get good grades	−.13	−.08	.13	.19	**.77**	**.53**
Selling illegal drugs	−.17	−.07	.24	.38	**.72**	**.47**
Intentionally lying during a business transaction	.07	−.06	−.07	.08	**.71**	**.61**
A business owner making a very high salary but keeping his employees at minimum wage	−.01	.23	.07	−.17	**.71**	**.45**
A member of a work group choosing not to contribute anything but sharing equally in all the benefits	−.01	.10	−.06	−.18	**.69**	**.42**
Stealing from a neighbor	.04	−.09	.12	.08	**.62**	**.62**
Someone who is addicted to pill drugs	.02	.09	.07	.26	**.58**	**.43**
Someone who is addicted to IV drugs	.05	.21	.08	.18	**.50**	**.42**
A parent ignoring their crying child	.19	.21	−.10	.06	**.47**	.38
Wishing one's spouse was dead	.17	.07	−.10	.09	**.44**	**.43**
Thinking of cheating on a long-term romantic partner	−.20	−.11	.06	.12	.39	**.45**
A poor couple selling their child to a rich couple	.21	.14	−.13	.22	.39	.16
Illegal immigrant workers	.19	.04	.06	.15	.37	.08

Note. Factor loadings above .40 are bolded.

correlated ($r = .26$). Factor scores were calculated using a regression estimate.

Sex differences across factors. A 3 (disgust factor: within subjects) × 2 (participant sex: between subjects) analysis of variance (ANOVA) on disgust sensitivity scores yielded an interaction between disgust domain and participant sex, $F(2, 157) = 13.56$, $p < .001$. Although women scored higher than men on disgust sensitivity across all three factors, this sex difference varied substantially across domains (sex difference, measured in Cohen's *d*, for pathogen = 0.32, sexual = 1.07, moral = 0.32). Consistent with predictions, planned contrasts of the interaction demonstrated that the sex difference in disgust sensitivity was similar across the pathogen and moral domains, $t(158) = 0.09$, $p = .93$, but was greater for the sexual domain than the other two, $t(158) = 5.20$, $p < .001$. These sex differences were large across the nine items that loaded .3 or above on the sexual disgust factor. Of these items, all but two ("going to a nude beach," $d = 0.28$, and "hearing two strangers have sex," $d = 0.38$) had Cohen's *d*s of 0.60 or above. Of the remaining seven items, the smallest sex difference ("watching pornography," $d = 0.60$) was greater than the sex difference for 32 of the 33 items that loaded above .3 on the pathogen and moral factors, with the exception being "finding a hair in your food" ($d = 0.63$).

Discussion

A factor analysis suggested that disgust reactions to a wide and varied array of concepts can be empirically categorized into domains related to pathogens, sexuality, and morality. Items used in the analysis encompassed a broad range of objects, behaviors, and situations within each domain. For example, the pathogen factor included concepts that, under the model suggested by Rozin et al. (2000), could be categorized as core disgust, animal reminder disgust, or interpersonal disgust. Items on the moral factor included behaviors related to theft, dishonesty, and nonreciprocity, and items on the sexual factor included behaviors related to promiscuity, specific sexual acts, and partner choice.

Although a number of outcomes could have emerged in our factor analysis (a single general disgust factor; a social and a nonsocial factor; factors mapping onto domains of core disgust, animal reminder disgust, and interpersonal disgust, etc.), we found that the majority of items loaded onto one and only one of the three factors predicted by our theoretical model. This raises the question of why we found this pattern whereas previous research using the Disgust Scale and Disgust Scale-R has shown that other domains, such as animal reminder disgust, appear in data analyses.

Methodological differences may contribute to these different results. For example, the majority of items used in the animal reminder domain of the Disgust Scale-R do not directly ask participants about disgust. Instead, many items ask participants to indicate the extent to which they agree or disagree with statements that can be characterized as creepy and uncanny (e.g., "I would go out of my way to avoid walking through a graveyard"; "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"; "it would not upset me at all to watch a person with a glass eye take the eye out of the socket"; "it would bother me to be in a science class, and to see a human hand preserved in a jar"; "it would bother me tremendously to touch a dead body"). Although the creepiness felt toward walking through a graveyard or sleeping in the bed previously occupied by a heart attack victim may share some phenomenological similarity with disgust, these questions do not directly measure a disgust response. Instead, they ask about the degree to which one is bothered or upset by a particular act, making it unclear whether the emotion being measured is disgust or something else (e.g., sadness, fear, anger, surprise). In our study, all items directly concern disgust, thus rendering the construct represented in our measure more straightforwardly interpretable as sensitivity to disgust.

Consistent with past research on individual differences in disgust sensitivity, women reported stronger disgust responses than men across domains. However, in line with the logic of an adaptationist perspective, this sex difference was by far the strongest in the sexual domain. Whereas the sex differences in the pathogen and moral domains were by convention small, the sex difference in the sexual domain was very large. This large effect likely exists because women pay higher biological costs (e.g., time and energy costs, sexually transmitted disease risks, pregnancy risks) than men for making sexual "mistakes"—that is, choosing sexual partners and behaviors that jeopardize the risk of producing healthy offspring (Trivers, 1972)—and should be more motivated than men to avoid such encounters. Our data demonstrate that women indeed find specifically sexual concepts especially more disgusting than do men. In concert with factor analytic results, the varied strength of the sex difference in disgust sensitivity across domains further demonstrates that sexual disgust is distinct from pathogen and moral disgust.

Study 2

Study 1 provided initial support for the distinctiveness of pathogen, sexual, and moral disgust. We sought to further explore the differentiability of these three factors in Study 2. Specifically, we predicted that the factors identified in Study 1 would show different relationships with other validated constructs, including the following.

Primary Psychopathy

Primary psychopathy is a continuous dimension reflecting a lack of concern with others' welfare and a willingness to achieve goals via antisocial behaviors such as lying and cheating (M. R. Levenson, Kiehl, & Fitzpatrick, 1995). Given that morals can be viewed as a set of rules designed to maintain social cohesion within groups (Baumeister & Exline, 1999), we predicted that sensitivity to moral disgust would be negatively related to primary psychopathy. That is, individuals who report greater antisocial attitudes should be less sensitive to moral disgust. Also, given that nonnormative sexuality is often morally censured (Lieberman et al., 2003), we predicted that primary psychopathy would also be negatively related to sensitivity to sexual disgust. Indeed, sexual promiscuity is one characteristic of psychopathy (Hare, 1991). However, given that primary psychopathy impacts aspects of sociality (e.g., antisocial personality traits and behaviors), and moral judgments and mate choice come under this umbrella whereas pathogen avoidance (at least as relates to blood, guts, and gore) does not, we did not expect a significant relationship between pathogen disgust and primary psychopathy.

Perceived Vulnerability to Disease

Individuals differ in their perceived vulnerability to disease (PVD; Faulkner, Schaller, Park, & Duncan, 2004). In its initial development, the PVD scale was found to relate to the original Disgust Scale. From our theoretical perspective, PVD should positively correlate with sensitivity to pathogen disgust, because both constructs are related to disease avoidance and because of the conceptual overlap between pathogen disgust and the Disgust Scale. Further, sensitivity to sexual disgust should also be related to PVD given the potential disease risks associated with sex and the roles that assessments of health and pathogen presence play in mate choice. However, moral disgust is not related to avoiding pathogen threats and should not be related to PVD.

Big Five Personality Traits

In contrast with our inclusion of measures of psychopathy and PVD, which were motivated by a priori hypotheses, our motivations for including a measure of Big Five personality dimensions were more exploratory. In their development of the Disgust Scale, Haidt et al. (1994) found disgust sensitivity to relate positively to neuroticism. Our theoretical perspective suggests that the Disgust Scale considers sensitivity to pathogen disgust, but not sexual disgust or moral disgust. For this reason, we predicted that pathogen disgust (but not necessarily sexual or moral disgust) should be positively related to neuroticism. Further, given the domains' functional specificity, we expected that the three domains would show unique patterns of relations with Big Five dimensions. For example, agreeableness is a social attribute and may relate to moral and sexual disgust but not to pathogen disgust.

Method

Participants and procedures. Three hundred undergraduate psychology students (168 women, 132 men) at a major university geographically different from that in Study 1 participated in the study. Participant age ($M = 20.25$ years, $SD = 3.82$) was similar to that in Study 1. Participants completed the survey online at their own convenience in exchange for course credit.

Measures. Because we wanted to replicate the sex differences and the factor analysis results from Study 1, participants rated their disgust responses to the same 48 items used in Study 1. They also completed the PVD scale (Faulkner et al., 2004), the Primary Psychopathy Scale (M. R. Levenson et al., 1995), and the Big Five Inventory (BFI; Benet-Martinez & John, 1998).

Results

Factor structure of disgust sensitivity. We factor analyzed the 48 disgust items using the same procedures detailed in Study 1 (see Table 1 for items and factor loadings), and the first 10 eigenvalues were 10.55, 3.63, 2.74, 1.91, 1.63, 1.44, 1.38, 1.32, 1.18, and 1.11. Again, we used a visual scree test and a parallel analysis (consisting of 5,000 simulations of random data with 300 cases and 48 variables) to determine the number of factors to extract. The visual scree test suggested that three factors be extracted. However, the parallel analysis indicated that the first 4 eigenvalues surpassed the 95th percentile of the simulated eigenvalues, suggesting that four factors be extracted. Given the conflicting results between the two criteria, we extracted and rotated obliquely three-factor and four-factor solutions and examined item loadings on each pattern matrix to determine which solution was most appropriate.

As in Study 1, a four-factor solution straightforwardly indicated a pathogen factor (the three highest loading items being "accidentally touching someone's bloody cut," "standing next to someone on the bus who has strong body odor," "shaking hands with a stranger who has sweaty palms"), a sexual factor (the three highest loading items being "watching pornography," "going to a nude beach," "having anal sex with someone of the opposite sex"), a moral factor (the three highest loading items being "a mechanic overcharging elderly people," "stealing bank account information online," "stealing from a neighbor"), and a fourth factor that was characterized by only a few items with diffuse loadings. For the fourth factor, only one item loaded uniquely above .5 ("being hit on by an attractive individual of the same sex"), one other item loaded uniquely above .4 ("a woman terminating her pregnancy"), and one other item loaded uniquely above .3 ("illegal immigrant workers"). Three other items loaded above .3 on this factor (though none of these items loaded above .4) but had higher loadings on other factors ("stepping in a large pile of dog poop," "someone who is addicted to pill drugs," "someone who is addicted to IV drugs"). Importantly, only one item that loaded above .3 on a fourth factor in Study 1 also loaded above .3 on a fourth factor in Study 2 ("being hit on by an attractive individual of the same sex").

A three-factor solution was highly similar to the first three factors of a four-factor solution and was highly similar to the three factors from Study 1 (see Table 1 for item loadings). That is, item loadings indicated clear pathogen, sexual, and moral factors. All but four items loaded at least .3 on one of the factors, and of the remaining 44 items, all but four loaded .3 on only one factor. Given (a) the similarity between the three-factor solutions in Studies 1 and 2, (b) the consistency of the pathogen, sexual, and moral factors across three- and four-factor solutions, (c) the lack of conceptual cohesiveness of a four-factor solution, (d) the lack of similarity between the fourth factors across Studies 1 and 2, and (e) our theoretical framework predicting the existence of these functional domains of disgust, we used the three-factor solution. The pathogen factor was correlated with the sex factor ($r = .42$) and the moral factor ($r = .28$), and the sex and moral factors were correlated ($r = .28$). As in Study 1, factor scores were computed with a regression estimate.

How the domains relate to primary psychopathy, PVD, and the Big Five. As detailed in Table 2, zero-order correlations were used to examine the relationships between the three disgust domains and other relevant constructs. We also used procedures for testing dependent correlations detailed by Meng, Rosenthal, and Rubin (1992) to test if the correlations with other constructs differed significantly between disgust domains.

Both primary psychopathy and PVD differentially related to the three disgust domains in a manner consistent with our predictions. Primary psychopathy was negatively related to sensitivity to moral disgust ($r = –.38$, $p < .001$) and sexual disgust ($r = –.25$, $p < .001$), but it was not related to sensitivity to pathogen disgust ($r = .02$, $p = .75$). The relationship with primary psychopathy was stronger for moral disgust than for sexual disgust ($z = 2.08$, $p < .05$). As predicted, scores of PVD were related to the pathogen domain ($r = .26$, $p < .001$) and the sexual domain ($r = .36$, $p <$

Table 2
Correlations Between Sensitivity to Disgust Domains and Other Constructs (Study 2)

Measure	Disgust sensitivity domain		
	Pathogen	Sexual	Moral
Primary psychopathy	$-.02_{SM}$	$\mathbf{-.25}_{PM}$	$\mathbf{-.38}_{PS}$
Perceived vulnerability to disease	$\mathbf{.26}_{M}$	$\mathbf{.36}_{M}$	$.06_{PS}$
Big Five			
Agreeableness	$.04_{SM}$	$\mathbf{.19}_{P}$	$\mathbf{.23}_{P}$
Conscientiousness	$-.04_{SM}$	$\mathbf{.15}_{P}$	$\mathbf{.21}_{P}$
Extraversion	.08	$-.02_{M}$	$\mathbf{.12}_{S}$
Neuroticism	$\mathbf{.15}_{M}$	.04	$-.04_{P}$
Openness	$-.11_{M}$	$\mathbf{-.13}_{M}$	$.05_{PS}$

Note. Bolded correlation coefficients indicate significance at the $p < .05$ level. Subscripts (P = pathogen, S = sexual, M = moral) indicate that the correlation is significantly different from that with another disgust domain at the $p < .05$ level. The absence of a subscript indicates that the correlation is not significantly different from that with the other two disgust domains.

.001) but not the moral domain ($r = .06$, $p = .31$). The correlations between PVD and disgust sensitivity did not differ significantly between the sexual and pathogen domains ($z = 1.84$, $p = .07$).

In our exploratory analyses, the Big Five traits were differentially related to the three domains of disgust sensitivity (see Table 2 for bivariate correlations). Sensitivity to pathogen disgust was positively related to neuroticism; sensitivity to sexual disgust was positively related to conscientiousness and agreeableness and negatively related to openness; and sensitivity to moral disgust was positively related to extraversion, agreeableness, and conscientiousness. Notably, none of the correlations between disgust sensitivity and Big Five traits surpassed $r = .23$. So although the distinct relationships between disgust domains and Big Five traits further demonstrated that the domains are indeed distinct, the relationships' modest magnitudes indicate that sensitivity to disgust is unique from any Big Five trait.

Sex differences across factors. A 3 (disgust factor: within subjects) × 2 (participant sex: between subjects) ANOVA on disgust sensitivity was conducted to replicate the sex differences observed in Study 1. The analysis indicated an interaction between disgust domain and participant sex, $F(2, 297) = 9.70$, $p < .001$. As in Study 1, women on average scored higher than men across domains (Cohen's *d*, for pathogen = 0.08, sexual = 0.60, moral = 0.29), and the sex difference was especially pronounced on the sexual domain (see Figure 1). Interaction contrasts again demonstrated that the sex difference in disgust sensitivity was similar across the pathogen and moral domains, $t(298) = 1.59$, $p = .12$, but was greater for the sex domain than the other two, $t(298) = 3.75$, $p < .001$.

Discussion

Item loadings offered additional support for the results obtained in Study 1. Out of a large set of items describing "disgusting" concepts, reported intensity of disgust responses clustered into factors of pathogen, sexual, and moral disgust. Similar to Study 1, we observed the predicted sex difference in factor scores across the domains, with women's sensitivity to disgust being especially greater on the sexual domain compared with the pathogen and moral domains.

Sensitivity to the three disgust domains differentially related to other personality constructs in a manner consistent with our predictions. According to our theoretical model, moral disgust—and to an extent sexual disgust—relate to how people interact, and they both demonstrated negative relationships with psychopathic tendencies, although moral disgust was more strongly negatively related. In contrast, pathogen disgust was not related to psychopathic tendencies. Pathogen disgust and to an extent sexual disgust function to motivate disease-avoidant behaviors, and they—but not moral disgust—were indeed related to PVD, the degree to which individuals feel threatened by disease. These results are important for two reasons. First, they demonstrate convergent validity in a manner consistent with our theoretical framework. Second, they further demonstrate that the domains are distinct. Sensitivity to sexual disgust, although showing a similar relationship with PVD as sensitivity to pathogen disgust and a similar relationship with primary psychopathy as sensitivity to moral disgust, also showed a distinct relationship with PVD from sensitivity to moral disgust and a distinct relationship with primary psychopathy from sensitivity to pathogen disgust.

The disgust domains also differentially related to the Big Five personality dimensions. Previous findings have demonstrated that disgust sensitivity is related to neuroticism (Haidt et al., 1994). Our perspective contends that previous conceptions of disgust sensitivity as measured by the Disgust Scale have primarily considered sensitivity to pathogen disgust and that the pathogen domain specifically should be related to neuroticism. Results confirmed this prediction: Sensitivity to pathogen disgust—but not sexual or moral disgust—was related to neuroticism. The differential relations with the Big Five personality dimensions further demonstrate that sensitivity to pathogen, sexual, and moral disgust are indeed distinct constructs.

Study 3

Studies 1 and 2 demonstrated that individual differences in disgust sensitivity can be categorized into domains of pathogen, sexual, and moral disgust, dissociable in their relationships with

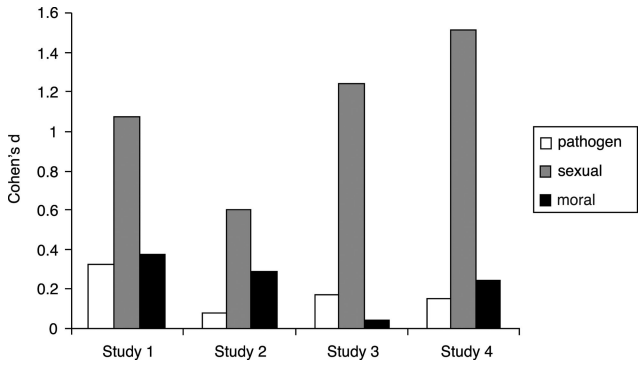


Figure 1. Sex differences in disgust sensitivity are greater on the sexual domain than the pathogen and moral domains. Cohen's *d*s are reported, with all *d*s indicating greater sensitivity for women.

participant sex and other personality constructs. However, these studies were conducted using samples of undergraduate college students with a limited range of age, income, geographic location, and so forth. In Study 3, we sampled adults from every state in the United States to see if the three disgust domains were dissociable among a more diverse sample.

Method

Participants and procedures. Participants were recruited through postings to online classified advertisements in communities around the United States. In total, 1,118 adults (847 women, 271 men) participated in the study by completing the survey online. Participant age was greater than the college samples ($M = 33.64$ years) and more variable ($SD = 10.91$). The sample consisted of participants from all 50 U.S. states and the District of Columbia.

Measures. After examining the 48 items used in Studies 1 and 2, we identified 9 items from each domain that had high factor loadings across both studies. Hence, we asked participants to report their disgust reactions to 27 items, 9 from each domain.

Results

Factor structure of disgust sensitivity. Building on the consistent results from in Studies 1 and 2, we used a CFA to examine model fit. We conducted analyses using EQS 6.1. First, we examined a measurement model in which all 27 items were constrained to load on a single factor. This model demonstrated poor fit, $\chi^2(324, N = 1{,}118) = 6{,}458.42$, $p < .01$, confirmatory fit index (CFI) = .49, root-mean-square error of approximation (RMSEA) = .130, standardized root-mean-residual (SRMR) = .133, further suggesting that sensitivity to disgust is not a unitary construct. The subsequently tested three-factor model demonstrated significantly better fit than the single-factor model, $\Delta\chi^2(3, N = 507) = 4{,}480.33$, $p < .01$; three-factor model, $\chi^2(321, N = 1{,}118) = 1{,}978.09$, $p < .01$, CFI = .86, RMSEA = .068, SRMR = .057. For the three-factor model, item loadings ranged from .49 to .83.

We also conducted a Lagrange Multiplier (LM) test, which identifies paths not included in the model that would significantly improve model fit, and a Wald test, which identifies paths included in the model that can be dropped without reducing model fit. The LM test did not indicate that any items loaded on multiple factors, and the Wald test indicated that each item loaded significantly on its specified factor.

Items were unit weighted to create factor scores. As in Studies 1 and 2, the pathogen factor was positively related to the sex ($r = .34$) and moral ($r = .39$) factors, and the sex and moral factors were positively related ($r = .26$). Cronbach's alpha was high for each factor (pathogen = .83, sexual = .86, moral = .89).

Compared to cutoffs suggested by Hu and Bentler (1999), the model demonstrated only marginally good or poor fit. Although the SRMR indicated good fit relative to the conventional cutoff of .08, the CFI and RMSEA did not indicate good fit relative to conventional cutoffs (.95 and .06, respectively). However, given that item-level multidimensional measures that are otherwise empirically reliable often fail to meet conventional standards for good fit (Ferrando & Lorenzo-Seva, 2000; McCrae, Zonderman, Costa, Bond, & Paunonen, 1996), the combination of a good SRMR, marginal RMSEA, moderate to high factor loadings, lack of cross-loadings, and good internal reliability suggests an acceptable factor structure.

Sex differences in disgust sensitivity. A mixed 3 (disgust factor: within subjects) $\times$ 2 (participant sex: between subjects) ANOVA demonstrated an interaction between sex and disgust domain, $F(2, 1115) = 142.42$, $p < .001$ (Cohen's d for pathogen = 0.17, sexual = 1.24, moral = 0.04). Simple effect tests indicated that women were more sensitive to pathogen disgust, $t(1116) = 2.44$, $p < .05$, and sexual disgust, $t(1116) = 17.79$, $p < .001$, but the sexes did not differ in sensitivity to moral disgust, $t(1116) = 0.63$, $p = .53$. Interaction contrasts indicated that the sex difference was different between each domain at the .05 level. Hence, the sex different in disgust sensitivity was greater in the sexual domain than in the pathogen and moral domains (see Figure 1).

Discussion

This larger, more diverse sample confirmed the three-domain factor structure observed in undergraduate university students in Studies 1 and 2. Further, we replicated the sex differences found previously, whereby there was a much larger sex difference in the sexual domain than in the other two domains.

Study 4

Study 4 investigated how our model of disgust empirically relates to and can be distinguished from the dominant model of disgust sensitivity proposed by Haidt et al. (1994), which motivated the creation of the Disgust Scale. Rather than testing how pathogen, sexual, and moral disgust relate to the eight domains measured in the original Disgust Scale, we believed a more useful and telling investigation would compare these three domains with the revised version of the scale (the Disgust Scale-R; Olatunji et al., 2007), which is statistically more valid and reliable than the original Disgust Scale. Despite the use of the original Disgust Scale in over 100 studies, its psychometric properties were questioned by Olatunji et al. (2007), who reanalyzed the original 32-item measure and found little evidence for the eight-factor structure under which the Disgust Scale was originally constructed. After removing seven items with poor factor loadings—including all four items tapping sexual disgust—they found the remaining 25-item Disgust Scale-R to consist of three highly correlated factors. On the basis of conceptual domains proposed by Rozin et al. (2000), Olatunji et al. (2007) described these factors as measuring sensitivity to core disgust (e.g., "you are about to drink a glass of milk and smell that it is spoiled"; "you see maggots on a piece of meat in an outdoor garbage pail"), animal reminder disgust (e.g., "you see a man with his intestines exposed after an accident"; "your friend's pet cat dies and you have to pick up the dead body with your hands"), and contamination disgust (e.g., "a friend offers you a piece of chocolate shaped like dog-doo"; "you take a sip of soda and realize that you drank from the glass that an acquaintance of yours had been drinking from"). Comparing our measure with the Disgust Scale-R allows us to see how evolutionarily derived domains of pathogen, sexual, and moral disgust relate to domains of core, animal reminder, and contamination disgust. It also allows for some tests of competing predictions from both models.

From the perspective summarized by Rozin et al. (2000), an animal reminder domain of disgust functions to motivate people to reject reminders of their animal origins. The major elicitors of

animal reminder disgust include sex, death, hygiene, and envelope violations. Although this perspective has been echoed multiple times (e.g., Goldenberg et al., 2000, 2001; Haidt et al., 1994, 1997; Olatunji, 2008; Olatunji et al., 2007; Rozin & Fallon, 1987) and is often taken as a core theoretical assumption in modern perspectives on disgust, little empirical evidence supports the claim that these purported reminders of animality form a single disgust domain.

Our development of a measure of sensitivity to sexual disgust allows for a critical test of a major assumption of the animal reminder theory: If sex is truly part of the animal reminder domain, then sensitivity to sexual disgust should covary strongly with the animal reminder domain on the Disgust Scale-R. However, if, as we propose, disgust toward sexual concepts is unrelated to other purported reminders of animality, sensitivity to sexual disgust should not covary with the animal reminder domain of the Disgust Scale-R. Rather, we suggest that all three domains included in the Disgust Scale-R are strongly related to what we have described as pathogen disgust. To summarize, we have three clear predictions: (a) All three domains of the Disgust Scale-R will be highly correlated; (b) all three of the domains of the Disgust Scale-R will be strongly related to our measure of pathogen disgust but not to sexual disgust or moral disgust; and (c) sensitivity to sexual disgust will be unrelated to the animal reminder domain when controlling for sensitivity to pathogen disgust.

Method

Participants and procedures. Five-hundred-seven undergraduate psychology students from two major universities (309 women, 198 men) participated in the study in exchange for course credit. Participant age ($M = 19.63$ years, $SD = 3.02$) was consistent with that of previous studies using undergraduate samples.

Measures. Some item pairs from the 27 items used in Study 3 had correlated residual errors. These items were removed, leaving a 21-item measure—7 items on each domain—of disgust sensitivity. We subsequently refer to this measure as the Three-Domain Disgust Scale (see Appendix for items). The Three-Domain Disgust Scale was measured on a 7-point (0 to 6) Likert-type scale with responses anchored with *not at all disgusting* and *extremely disgusting*. Although the Disgust Scale-R has 13 true–false items (e.g., "if I see someone vomit, it makes me sick to my stomach") and 12 items on a 3-point response scale of *not disgusting*, *slightly disgusting*, and *very disgusting* (e.g., "you see someone put ketchup on vanilla ice cream and eat it"), we measured each item on the same 0–6 point scale as the Three-Domain Disgust Scale for this study. The 13 true–false items were anchored at 0 = *strongly disagree* and 6 = *strongly agree*, and the 12 disgust items were anchored at 0 = *not at all disgusting* and 6 = *extremely disgusting*.

Results

First, measurement models of the Three-Domain Disgust Scale and Disgust Scale-R were separately examined for fit. The three-factor structure of the Three-Domain Disgust Scale demonstrated acceptable fit, $\chi^2(186, N = 507) = 635.62$, $p < .01$, CFI = .89, RMSEA = .069, SRMR = .062, with factor loadings ranging from .52 to .80 (see Table 3 for factor loadings). Cronbach's alpha was good for each factor (moral disgust = .84, sexual disgust = .87, pathogen disgust = .84). Sensitivity to pathogen disgust was

Table 3
Factor Loadings for the Three-Domain Disgust Scale (Study 4)

Item	Disgust sensitivity domain			Sex difference (Cohen's *d*)
	Pathogen	Sexual	Moral	
Standing close to a person who has body odor	.74			−.06
Shaking hands with a stranger who has sweaty palms	.73			.10
Stepping on dog poop	.67			.10
Accidentally touching a person's bloody cut	.66			.15
Seeing some mold on old leftovers in your refrigerator	.64			.00
Sitting next to someone who has red sores on their arm	.62			−.09
Seeing a cockroach run across the floor	.52			.52
Bringing someone you just met back to your room to have sex		.80		1.51
Watching a pornographic video		.79		.94
A stranger of the opposite sex intentionally rubbing your thigh in an elevator		.71		1.83
Having anal sex with someone of the opposite sex		.70		1.00
Hearing two strangers having sex		.66		.80
Performing oral sex		.63		.63
Finding out that someone you don't like has sexual fantasies about you		.57		.66
Forging someone's signature on a legal document			.75	.20
Intentionally lying during a business transaction			.75	.27
Stealing from a neighbor			.69	.15
A student cheating to get good grades			.69	.27
Shoplifting a candy bar from a convenience store			.62	.09
Deceiving a friend			.58	.13
Cutting to the front of a line to purchase the last few tickets to a show			.56	.12
Descriptive statistics, *M* (*SD*)				
All participants	3.87 (1.19)	3.31 (1.52)	3.70 (1.14)	
Men	3.76 (1.14)	2.19 (1.21)	3.53 (1.07)	
Women	3.94 (1.21)	4.03 (1.23)	3.81 (1.17)	

positively related to sensitivity to sexual disgust ($r = .38$) and moral disgust ($r = .17$), and sensitivity to sexual disgust was positively related to sensitivity to moral disgust ($r = .39$).[3] An LM test and a Wald test were also run. The LM test indicated that adding a path from any factor to any item not specified to load on that factor would not improve model fit. The Wald test identified no paths that could be eliminated without significantly decreasing model fit. In sum, all items loaded on only the factor they were predicted to, and residual errors between items on separate factors did not covary.

A separate CFA in which Disgust Scale-R items were constrained to load on the three factors of core disgust, animal reminder disgust, and contamination disgust described by Olatunji et al. (2007) was also run with LM and Wald tests. It demonstrated acceptable fit, $\chi^2(272, N = 507) = 778.78$, $p < .01$, CFI = .84, RMSEA = .061, SRMR = .058. However, the Wald test noted that removing the item "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" (factor loading = .076) from the animal reminder factor would not change model fit, $\chi^2(1, N = 507) = 2.45$, $p = .117$. Also, the LM test indicated improved fit if the animal reminder disgust item "it would bother me tremendously to touch a dead body" were allowed to load onto the core disgust factor as well. Although removing these items marginally improved model fit, $\chi^2(227, N = 507) = 628.99$, $p < .01$, CFI = .86, RMSEA = .059, SRMR = .052, they were retained so that analyses could be conducted on the existing published measure. Cronbach's alphas were acceptable for the core disgust factor (.82) and animal reminder disgust factor (.78) but low for the contamination disgust factor (.65). Sensitivity to core disgust was highly correlated with sensitivity to animal reminder disgust ($r = .79$) and contamination disgust ($r = .73$), and sensitivity to animal reminder disgust and contamination disgust were also highly correlated ($r = .60$).

Our perspective suggests that the Three-Domain Disgust Scale does a better job of capturing the heterogeneity of disgust than the Disgust Scale-R. The average inter-item correlations within the core, animal reminder, and contamination domains of the Disgust Scale-R were .28, .34, and .27, respectively, whereas the average correlation between items on separate factors was .23. For the Three-Domain Disgust Scale, the average inter-item correlations within the pathogen, sexual, and moral domains were .43, .48, and .44, respectively, whereas the average correlation between items on separate factors was .15. Thus, there is less overlap between the constructs measured by the Three-Domain Disgust Scale than there is between those measured by the Disgust Scale-R. Indeed, constraining the three factors of the Disgust Scale-R to be perfectly correlated did not significantly diminish model fit, $\Delta\chi^2(3, N = 507) = 1.54$, $p = .67$. This means that a model in which the core domain, animal reminder domain, and contamination domain were correlated at $r = 1.00$ was statistically equivalent to the observed model in which the correlations between the factors were freely estimated. In sum, Prediction 1 was supported: The three domains of the Disgust Scale-R do not demonstrate strong distinctiveness—rather than reflecting the heterogeneity of disgust, they appear to measure very similar constructs.

To examine the correlations between Three-Domain Disgust Scale factors and Disgust Scale-R factors, we performed a CFA on both scales simultaneously and allowed the six latent variables to covary. Overall model fit was suboptimal, $\chi^2(974, N = 507) = 2{,}487.04$, CFI = .82, RMSEA = .055, SRMR = .062. Given that poor-fitting models can give inaccurate parameter estimates such as covariances between factors (Kline, 2005), we created three item parcels per domain with every third item in each domain and reran the analysis. This model fit the data well, $\chi^2(120, N = 507) = 338.91$, CFI = .95, RMSEA = .060, SRMR = .048.[4] The correlations between the latent variables supported our second prediction that all domains of the Disgust Scale-R would strongly relate to pathogen disgust but not sexual or moral disgust (see Table 4). Pathogen disgust was strongly correlated with core, animal reminder, and contamination disgust (rs = .92, .61, and .66, respectively), whereas sexual disgust was more modestly related (rs = .49, .29, and .45, respectively), and moral disgust was virtually unrelated (rs = .13, –.01, and .19, respectively).

Our third prediction suggested that, contrary to the perspective suggested by Rozin et al. (2000), sexual disgust is not a component of animal reminder disgust, and any relationship between sexual disgust and the animal reminder domain of the Disgust Scale-R should be statistically accounted for by pathogen disgust. To test these competing hypotheses, we compared two structural models, again using item parcels: the first in which the animal reminder and pathogen disgust latent variables were allowed to covary and both predicted the sexual disgust latent variable, and the second in which the path from animal reminder disgust to sexual disgust was constrained to zero. In the first model, $\chi^2(24, N = 507) = 119.00$, $p < .01$, CFI = .96, RMSEA = .088, SRMR = .052, the path from animal reminder to sexual disgust was $\beta = .08$, and the path from pathogen to sexual disgust was $\beta = .35$. In the second model, $\chi^2(25, N = 507) = 120.31$, $p < .01$, CFI = .96, RMSEA = .087, SRMR = .054, the path from pathogen to sexual disgust was $\beta = .41$. The second model in which the path from animal reminder to sexual disgust was removed fit no worse than the first model in which it was included, $\Delta\chi^2(1, N = 507) = 1.31$, $p = .25$ (see Figure 2). The data thus indicated that sexual disgust is unrelated to animal reminder disgust when pathogen disgust is controlled for. Even without controlling for pathogen disgust, the relationship between animal reminder disgust and sexual disgust is modest ($r = .29$)—much lower than the degree to which the other Disgust Scale-R factors relate with each other and with pathogen disgust (and in fact lower than the other two Disgust Scale-R factors relate to sexual disgust).

Discussion

A CFA on the Three-Domain Disgust Scale further supported the factor structure observed in Studies 1–3. Analyses of the Disgust Scale-R suggested that, even with improvements made by Olatunji et al. (2007), the model of disgust sensitivity proposed by Haidt et al. (1994) continues to be problematic from a measure-

[3] A mixed 3 (disgust factor: within subjects) × 2 (participant sex: between subjects) ANOVA on unit-weighted factor scores demonstrated an interaction between sex and disgust domain, $F(2, 504) = 126.32$, $p < .001$ (Cohen's d for pathogen = 0.15, sexual = 1.51, moral = 0.24). See Figure 1 for effect sizes of the sex difference across Studies 1–4.

[4] The correlations between latent variables were similar regardless of whether individual items or item parcels were used as indicators. One correlation coefficient differed by .08 between the methods; all other coefficients differed by less than .03.

Table 4
Correlations Between the Three-Domain Disgust Scale and the Disgust Scale—Revised Domains (Study 4)

Disgust domain	Cronbach's α	1	2	3	4	5	6
1. Pathogen	.84	—	.40	.20	.92	.61	.66
2. Sexual	.87		—	.36	.49	.29	.45
3. Moral	.84			—	.13	−.01	.19
4. Core	.82				—	.77	.76
5. Animal reminder	.78					—	.58
6. Contamination	.65						—

ment perspective. The three factors in the Disgust Scale-R were highly correlated, blurring their conceptual distinctiveness. Additionally, one item failed to load on its specified factor, one item loaded on multiple factors, and internal reliability for the contamination disgust factor was low.

The face validity of Disgust Scale-R items raises questions regarding the nature of core disgust, animal reminder disgust, and contamination disgust as theoretical constructs. For example, "a friend offers you a piece of chocolate shaped like dog-doo" is said to measure contamination disgust, whereas "if you see someone put ketchup on vanilla ice cream and eat it" and "you are about to drink a glass of milk when you smell that it is spoiled" are said to measure core disgust. All three items involve food, but the Haidt et al. (1994) model argues that feces-shaped fudge falls under contamination, whereas the milk item, which explicitly mentions contamination, is conceptualized as measuring core disgust. Moreover, only one of the eight animal reminder items references animals (a dead cat), whereas five of the core disgust items do (monkey meat, a rat, a cockroach, maggots, and an earthworm).

Further, 13 of the 25 items may not directly measure disgust. Many items on the Disgust Scale-R ask participants to indicate the degree to which they are bothered or upset by a particular act—not disgusted—making it unclear whether the emotion being measured is disgust or something else (e.g., sadness, fear, anger, surprise). For instance, several items in the animal reminder domain address aversion to acts that can be described as creepy or unsettling (e.g., "I would go out of my way to avoid walking through a graveyard"; "it would bother me to sleep in a nice hotel room if I knew a man had died of a heart attack in that room before"). Similarly, items in the contamination domain may address compulsive tendencies (e.g., "I never let any part of my body touch the toilet seat in a public restroom"), and items on the core domain may relate to sensation seeking (e.g., "I might be willing to try monkey meat, under some circumstances") and senses of etiquette (e.g., "it bothers me to hear someone clear a throat full of mucous"). Given the theoretically questionable nature of the constructs measured by the Disgust Scale-R, the high correlations between Disgust Scale-R domains (*r*s between domains ranging from .66 to .84 as reported by Olatunji et al., 2007; *r*s between .58 and .77 in Study 4), and the high correlations between Disgust Scale-R domains and our pathogen disgust domain (*r*s between .62 and .90), we suggest that the Disgust Scale-R largely reflects sensitivity to pathogen disgust, which is distinct from sensitivity to sexual and moral disgust.

Finally, we found evidence contrary to the model of disgust proposed by Rozin et al. (2000), in which sexual disgust is a component of animal reminder disgust. The animal reminder domain was more strongly related to the pathogen domain than the sexual domain, and the relationship between the animal reminder

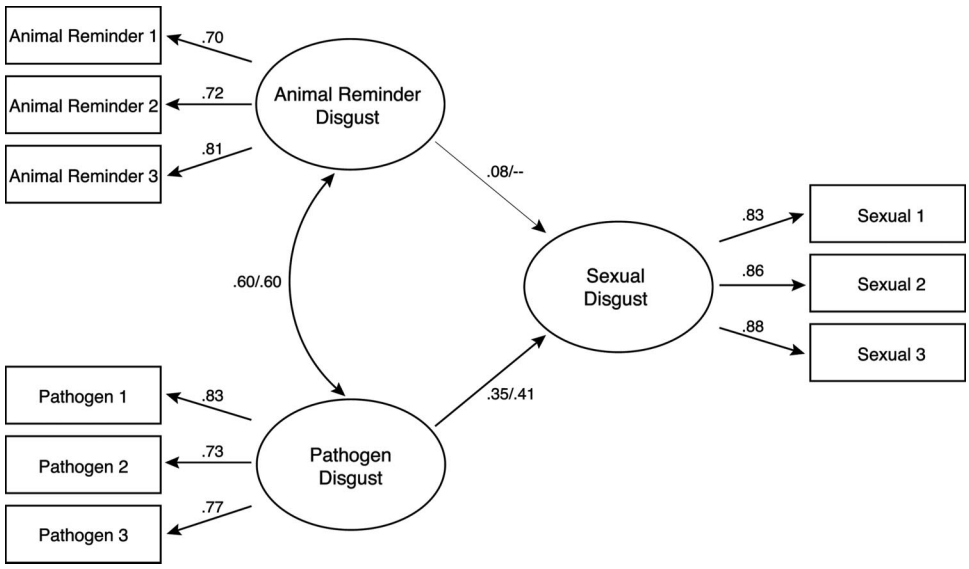


Figure 2. The diagram represents two structural models: the first in which the path from animal reminder to sexual disgust is freely estimated (standardized weights left of the slash) and the second in which the path is constrained to zero (standardized weights right of the slash). The second model fits the data as well as the first model, $\Delta\chi^2(1, N = 507) = 1.31$, $p = .25$. In both structural models, three item bundles from the Three-Domain Disgust Scale or Disgust Scale—Revised are used as indicators for each of the three latent variables.

and sexual domains was statistically accounted for by the pathogen domain. This result casts doubt on the theory that disgust toward sex fulfills the same function as disgust toward concepts related to death, envelope violations, and poor hygiene.

General Discussion

The current research suggests that individual differences in sensitivity to disgust can be conceptualized into three adaptively relevant domains: a pathogen domain, which functions to motivate avoidance of infectious microorganisms; a sexual domain, which functions to motivate avoidance of costly sexual behaviors; and a moral domain, which functions to motivate social avoidance of antisocial norm violators. Factor analyses across four studies demonstrated that individual differences in sensitivity to disgust can indeed be categorized along these three dimensions: Study 1 provided initial support for parsing disgust along these domains when reactions to a wide array of disgust elicitors were considered; Study 2 indicated that the three domains demonstrate discriminant validity, differentially relating to constructs such as primary psychopathy, PVD, and Big Five personality traits in manners consistent with our theoretical approach; Study 3 confirmed the factor structure suggested in Studies 1 and 2 in a diverse sample; and Study 4 introduced a new measure of disgust sensitivity, the Three-Domain Disgust Scale, and demonstrated that the construct measuring disgust sensitivity developed by Haidt et al. (1994) and modified by Olatunji et al. (2007) is strongly related to sensitivity to pathogen disgust but not sexual or moral disgust.

The model of disgust we propose is distinct from previous conceptualizations, and it provides an alternate theoretical and empirical lens for investigating the multiple functions of disgust. To guide our investigation, we considered the recurring selective pressures our hominid ancestors faced to generate hypotheses regarding the evolved functions of disgust (see also Curtis & Biran, 2001; Fessler & Navarrete, 2005). This approach calls into serious question the purported animal reminder function of disgust (Haidt et al., 1994; Rozin et al., 2000). As discussed by others (Fessler & Navarrete, 2005; Kirkpatrick & Navarrete, 2006), the evolution of such a function is highly improbable, and is it unclear whether people even actively avoid reminders that they are animals (Bloom, 2004; Royzman & Sabini, 2001). Whereas disgust associated with mate choice and sexual behaviors has previously been described as an example of animal reminder disgust, we suggest that sexual disgust is a distinct adaptive domain requiring unique sets of categorization procedures and decision rules pertaining to the mating arena.

Our revised conceptualization of disgust informed the development of a new instrument to measure individual differences in disgust sensitivities. This instrument not only measures sensitivity to pathogen disgust but also sensitivity to sexual disgust and moral disgust, both of which are absent in the Disgust Scale-R (Olatunji et al., 2007). The Three-Domain Disgust Scale we developed thus provides an empirically validated way to explore individual differences in sensitivity to sexual and moral disgust—two disgust domains that have largely been ignored—in addition to pathogen disgust, a construct we argue has been measured using existing measures of disgust sensitivity.

Whereas past research on disgust sensitivity has suggested that women are generally more sensitive than men to disgust (e.g., Druschel & Sherman, 1999; Haidt et al., 1994), our model predicts that sex differences in disgust sensitivity should vary across disgust domains. This prediction was supported across all four studies: Women's greater disgust sensitivity was consistently more pronounced in the sexual domain than the pathogen and moral domains. This pattern likely reflects the different fitness costs men and women potentially pay for choosing a particular individual as a sexual partner (Trivers, 1972). In contrast, men and women likely faced more similar selection pressures (though perhaps still not identical) when it came to avoiding disease and individuals inflicting social costs. For this reason, more muted sex differences were predicted and found in the pathogen and moral domains, respectively.

Future Directions

We have introduced an approach to disgust sensitivity suggesting that three broad, relatively independent selection pressures motivated the evolution of three distinct domains of disgust. We propose this model as a starting point from which to build and not necessarily a comprehensive view of disgust. As case in point, within each domain there are likely to be further interesting distinctions to draw. For instance, within the pathogen domain, there may be different sources of contamination (e.g., other individuals, foods, dead bodies). To the extent that these different sources rely on distinct cues signaling pathogen presence, there could be further meaningful variation in individual responses to these items. Some of the animal reminder items suggested by Rozin et al. (2000) may be particularly interesting to explore. For example, although gore and corpses certainly inspire disgust, they are also creepy and uncanny. This creepiness may serve additional functions beyond disease avoidance, or they may motivate a disease-avoidance response that is qualitatively distinct from pathogen disgust.

With respect to the sexual disgust domain, we indicated that avoidance of particular individuals as sexual partners should depend on, among other things, intrinsic qualities and genetic compatibility. Both dimensions rely on the evaluation of different features (e.g., those used to assess physical attractiveness vs. relatedness). This might lead to further distinctions within the sexual domain, especially when considering the factors that contribute to individual differences in attitudes toward various sexual behaviors. As an example, recent work has shown that disgust toward engaging in sex with one's sibling varies as a function of the presence of kinship cues such as duration of childhood coresidence with a sibling and seeing one's mother care for a sibling as a newborn (Lieberman, Tooby, & Cosmides, 2007). These cues predict intensities of aversions toward sibling sex but should not necessarily predict disgust toward sexual acts that do not involve a sibling (Park, 2008). Likewise, disgust toward other types of sexual behavior might vary as a function of separate factors yielding unique patterns of individual differences.

The same can be said of the moral disgust domain. There are a number of ways individuals can impose social costs—by cheating, cuckolding, defecting, lying, and so forth. Evaluating the occurrence of one of these acts and the magnitude of costs imposed (on oneself or members of one's social group) likely relies on different sets of information. In addition to the possibility that different computational systems underlie say, assessing whether one's mate has been unfaithful or whether someone has been stealing money

from you, different factors might contribute to individual differences across the myriad classes of moral transgressions. Future research endeavors may indeed uncover further differentiation to complement the model we have proposed and tested.

The model of disgust we propose also raises a series of new and interesting research questions across the psychological sciences. Given that pathogen, sexual, and moral disgust solve distinct adaptive problems, they may have different developmental trajectories. For instance, adaptations for guiding pathogen avoidance are required well before adaptations guiding mate choice, suggesting that pathogen disgust might develop earlier than sexual disgust (e.g., before puberty). The developmental patterns associated with moral disgust might be distinct from either pathogen or sexual disgust, perhaps even varying with the type of social interaction (e.g., dyadic social exchange vs. coalition formation). Although much has been done with respect to emotional and moral development (e.g., see Eisenberg, 2000; Fischer, Shaver, & Carnochan, 1990; Kohlberg, 1984; Soufre, 1997), the three-domain model of disgust we propose offers a new and rich source for further empirical inquiry.

Additional lines of investigation relate to the behavioral patterns and neural systems associated with the different functions of disgust. To the extent that the adaptive problems solved by pathogen, sexual, and moral disgust require different behavioral solutions, activation of a particular domain should coincide with those sets of behaviors. For instance, pathogen disgust might activate behaviors related to cleansing, whereas moral disgust might activate punitive and social exclusionary behaviors. The motivation of distinct behavioral patterns across domains further suggests the engagement of different neural systems. Given that the different disgust domains require unique sets of categorization and decision-making processes, they should activate distinct neural regions. Recent fMRI investigations using normal populations suggest this is indeed the case. In addition to activating common neural regions associated with a disgust response, imagination of acts associated with pathogen, sexual, and moral disgust also activated distinct regions in the brain (Moll et al., 2005; Schaich Borg et al., 2008). Further, evidence from patients with lesions in particular brain regions has shown dissociations between sensitivities to pathogen and sexual disgust (Calder et al., 2000). Despite this emerging evidence, the existence of moral disgust remains controversial. Future research endeavors may not only provide further insight into the distinction between pathogen, sexual, and moral disgust but also explore distinctions between the emotions such as contempt, anger, and disgust—three emotions proposed to regulate morality (Rozin, Lowery, Imada, & Haidt, 1999).

Our model also has important implications for the fields of clinical neuroscience and neuropsychology. One question our approach raises is whether groups shown to possess deficits in disgust processing are impaired in processing all types of disgust or only particular domains. For instance, Huntington's disease patients have shown selective impairments in disgust (Sprengelmeyer et al., 1996). It is uncertain, however, whether these impairments span all domains of disgust or are confined to only one or two. Similar questions emerge regarding individuals with obsessive–compulsive disorder and patients with brain lesions to the insula and other structures associated with disgust.

In general, pathogen disgust may be relevant to areas of research involving contagion and disease such as health psychology and public health policy; sexual disgust is relevant not only to research on mate choice and sexual harassment but also may be a valuable construct within the clinical setting (e.g., for individuals with sexual disorders) and the legal sphere (e.g., as related to legal cases involving rape, incest, and sexual abuse); and moral disgust, while also tightly connected to the legal sphere, is highly relevant to research on cooperation, altruism, and other social group processes as well as clinical conditions such as psychopathy and related antisocial disorders.

Concluding Remarks

It is our hope that this three-domain model of disgust will encourage researchers who have investigated individual differences in disgust sensitivity to consider the extent to which various constructs relate to the distinct functional domains of disgust. Constructs that have been found to relate to previous instruments measuring disgust sensitivity (e.g., tendencies toward compulsions, eating disorders, blood phobias, animal phobias, stigmatization, etc.) may be found to relate to pathogen disgust but not sexual or moral disgust. Conversely, constructs that have not previously been thought to relate to disgust sensitivity may not be related to sensitivity to pathogen disgust but rather to sexual or moral disgust. Given that previous disgust instruments have not adequately measured these two domains, such questions have yet to be fully explored.

As several theorists have pointed out, disgust plays a strong role shaping a variety of social processes, including prejudice, ethnocentrism, social exclusion, responses to perceived stigma, and phobias (Cottrell & Neuberg, 2005; Kurzban & Leary, 2001; Navarrete & Fessler, 2006; Olatunji & Sawchuk, 2005; Pryor, Reeder, Yeadon, & Hesson-McInnis, 2004). For this role to be fully understood, it is important to clarify the processes regulating each functional domain of disgust because different social attitudes and behaviors may stem from decision rules specific to each domain. Ultimately, to address and potentially change attitudes relating to particular social phenomena, it will be critical to understand the origin of our emotional responses. Disgust, an emotion governing social and nonsocial behaviors alike, is one of the central emotions key to providing insight into how we think about and relate to all members of our social environment.

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(*Appendix follows*)

Appendix

Three-Domain Disgust Scale

The following items describe a variety of concepts. Please rate how *disgusting* you find the concepts described in the items, where 0 means that you do not find the concept disgusting at all and 6 means that you find the concept extremely disgusting.

	Not at all disgusting						Extremely disgusting
1. Shoplifting a candy bar from a convenience store	0	1	2	3	4	5	6
2. Hearing two strangers having sex	0	1	2	3	4	5	6
3. Stepping on dog poop	0	1	2	3	4	5	6
4. Stealing from a neighbor	0	1	2	3	4	5	6
5. Performing oral sex	0	1	2	3	4	5	6
6. Sitting next to someone who has red sores on their arm	0	1	2	3	4	5	6
7. A student cheating to get good grades	0	1	2	3	4	5	6
8. Watching a pornographic video	0	1	2	3	4	5	6
9. Shaking hands with a stranger who has sweaty palms	0	1	2	3	4	5	6
10. Deceiving a friend	0	1	2	3	4	5	6
11. Finding out that someone you don't like has sexual fantasies about you	0	1	2	3	4	5	6
12. Seeing some mold on old leftovers in your refrigerator	0	1	2	3	4	5	6
13. Forging someone's signature on a legal document	0	1	2	3	4	5	6
14. Bringing someone you just met back to your room to have sex	0	1	2	3	4	5	6
15. Standing close to a person who has body odor	0	1	2	3	4	5	6
16. Cutting to the front of a line to purchase the last few tickets to a show	0	1	2	3	4	5	6
17. A stranger of the opposite sex intentionally rubbing your thigh in an elevator	0	1	2	3	4	5	6
18. Seeing a cockroach run across the floor	0	1	2	3	4	5	6
19. Intentionally lying during a business transaction	0	1	2	3	4	5	6
20. Having anal sex with someone of the opposite sex	0	1	2	3	4	5	6
21. Accidentally touching a person's bloody cut	0	1	2	3	4	5	6

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