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Sex Differences in Disgust: Why Are Women More Easily Disgusted Than Men?

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Abstract

Women have consistently higher levels of disgust than men. This sex difference is substantial in magnitude, highly replicable, emerges with diverse assessment methods, and affects a wide array of outcomes—including job selection, mate choice, food aversions, and psychological disorders. Despite the importance of this far-reaching sex difference, sound theoretical explanations have lagged behind the empirical discoveries. In this article, we focus on the evolutionary-functional level of analysis, outlining hypotheses capable of explaining why women have higher levels of disgust than men. We present four hypotheses for sexual disgust and six for pathogen disgust, along with testable predictions. Discussion focuses on additional new hypotheses and on future research capable of adjudicating among these competing, but not mutually exclusive, hypotheses.

Keywords

disgust, emotion, evolution, sex differences

Introduction

The emotion of disgust has far-reaching implications for several areas of psychology, from cognition and social relationships to health and the etiology and treatment of psychological disorders (e.g., Schaller, 2016). Disgust affects ingroup–outgroup psychology (Hodson & Costello, 2007); stereotyping and prejudice (Dasgupta, DeSteno, Williams, & Hunsinger, 2009); conservatism, liberalism, and political attitudes (Inbar, Pizarro, Iyer, & Haidt, 2012); and moral judgments (Inbar et al., 2012). The emotion of disgust is also linked to sexual intercourse, sexual arousal, and mate preferences (Al-Shawaf, Lewis, & Buss, 2014; Borg & de Jong, 2012; DeBruine, Jones, Tybur, Lieberman, & Griskevicius, 2010; Fleischman, 2014; Fleischman, Hamilton, Fessler, & Meston, 2015); eating and food preferences (Al-Shawaf, Lewis, Alley, &

Buss, 2015; Fallon, Rozin, & Pliner, 1984; Hoeffling et al., 2009); judgment and decision-making (Han, Lerner, & Keltner, 2007; Lerner, Small, & Loewenstein, 2004); and hygiene and health behavior (Curtis & Biran, 2001; Fleischman et al., 2011). Disgust has also been implicated in psychological disorders, including obsessive-compulsive disorder (OCD; Sprengelmeyer et al., 1997), sexual dysfunctions (Phillips, Senior, Fahy, & David, 1998), animal phobias (Mulken, de Jong, & Merckelbach, 1996), Huntington's disease (Sprengelmeyer et al., 1996), coprophagia (Phillips et al., 1998), and eating disorders (Troop, Treasure, & Serpell, 2002). Gaining a deeper understanding of disgust can help us achieve a deeper understanding of a wide array of psychological phenomena.

The last few decades of disgust research have demonstrated a robust sex difference in disgust: women have substantially higher levels of disgust than men (e.g., Al-Shawaf & Lewis, 2013; Curtis, Aunger, & Rabie, 2004; Haidt, McCauley, & Rozin, 1994; Oaten, Stevenson, & Case, 2009; Schienle, Schäfer, Stark, Walter, & Vaitl, 2005; Tybur, Lieberman, & Giskevicius, 2009). This effect holds for both self-report and behavioral data (Haidt et al., 1994; Oaten et al., 2009; Porzig-Drummond, Stevenson, Case, & Oaten, 2009; Rozin, Haidt, McCauley, Dunlop, & Ashmore, 1999) and for both trait-level and state-level responses to disgusting stimuli (Curtis et al., 2004; Haidt et al., 1994; Tybur et al., 2009).

This is not a trivial difference. In the domain of sexual disgust, for example, the effect sizes range from .60 to 1.54 (e.g., Al-Shawaf et al., 2014; Tybur et al., 2009). Women's lower threshold for disgust has been documented in studies of imagining incest (Lieberman, Tooby, & Cosmides, 2007), reactions to images of insects, open sores, dirty clothing, feces, and other potential sources of contamination (Curtis et al., 2004; Prokop & Jančovičová, 2010), statements about animals, death, hygiene, food, and sex (Haidt et al., 1994), and stable dispositions on disgust questionnaires (Curtis et al., 2004; Haidt et al., 1994; Tybur et al., 2009).

Sex differences in disgust affect diverse areas of human life, from interpersonal relationships to hygiene behavior to the professional realm (Al-Shawaf, Lewis, et al., 2015; Al-Shawaf et al., 2014; Fleischman et al., 2011; Loewenstein & Lerner, 2003). A breakdown of disgust-related professions by sex illustrates this well. Women are less likely to work in capacities that involve repeated encounters with pathogens—jobs that trigger strong disgust responses in many people. Although women constituted 46.2% of the overall labor force in the United States between 2010 and 2014 (The World Bank, 2015), in 2012, women made up less than 30% of the workforce in the “janitors and building cleaners” category. The numbers plummet further as the jobs get more disgusting: women comprised 14.4% of the waste management and remediation services industry and 13.8% of the sewage treatment workforce. These numbers are at their lowest for jobs like wastewater treatment operator (4.5%) and pest control worker (4.7%; U.S. Bureau of Labor Statistics, 2012). In short, sex differences in disgust appear to be connected to what we do for a living.

Surprisingly, the psychological sciences lack a deep theoretical explanation for *why* (Tinbergen, 1963) women exhibit higher levels of disgust than men. Several authors have suggested promising partial answers (e.g., Curtis, de Barra, & Aunger, 2011; Fessler, Pillsworth, & Flamson, 2004; Fleischman, 2014; Prokop & Jančovičová, 2013), but the field still lacks a systematic analysis of the issue. This article (a) collects and expands on existing explanations for sex differences in disgust, (b) offers separate conceptual analyses of sexual disgust and pathogen disgust, (c) proposes new hypotheses, and (d) suggests future empirical tests for testing and adjudicating between these hypotheses.

Women's Immunological Advantage

Women's greater disgust sensitivity is especially puzzling in light of their well-documented immunological superiority

(Christen, 1991). This immunological advantage affords women better protection than men from a variety of diseases, including cancer, heart diseases, respiratory diseases, cerebrovascular diseases, chronic obstructive pulmonary disease, pneumonia, and various diseases in infancy (Bouman, Heineman, & Faas, 2005; Christen, 1991; Pennell, Galligan, & Fish, 2012; Purtilo & Sullivan, 1979; Schröder, Kahlke, Staubach, Zabel, & Stüber, 1998; Schuurs & Verheul, 1990). Women have stronger immune responses at both the cellular and humoral levels (Bouman et al., 2005), resulting in more vigorous defenses against bacteria, viruses, and other parasites (Klein & Roberts, 2010; Purtilo & Sullivan, 1979). This includes higher serum immunoglobulin concentrations and greater antibody production in response to disease vectors (Purtilo & Sullivan, 1979). As a consequence, women are more than twice as likely as men to survive septic infections (Schröder et al., 1998). This female immunological superiority is sometimes referred to as the “male fragility” effect (Kernbaum, Tazi, & Champagne, 1976), which researchers have shown is partly attributable to the immunosuppressive effects of testosterone (e.g., Bhatia, Sekhon, & Kaur, 2014), as well as the presence of X-linked immunoregulatory genes that favor females over males (Purtilo & Sullivan, 1979). In light of this female immunological superiority and the pathogen-protection functions of disgust, the fact that women exhibit *higher* levels of disgust is striking and calls for explanation.

Different Types of Disgust

To move toward a comprehensive answer to this question, it will be necessary to investigate the different types of disgust. Different researchers have proposed different taxonomies of disgust (e.g., Haidt et al., 1994; Olatunji et al., 2007; Tybur et al., 2009), but in this article we will focus on a current classification scheme proposed by Tybur and colleagues. Rozin and colleagues' (Haidt et al., 1994) earlier seminal work was of great historical importance and spurred dozens of new researchers to investigate disgust, but it suffers from conceptual and psychometric limitations that render the model untenable (see Al-Shawaf & Lewis, 2013; Al-Shawaf, Lewis, et al., 2015; Fessler & Navarrete, 2005; Tybur et al., 2009). Recent work by Tybur and colleagues (Tybur et al., 2009; Tybur, Lieberman, Kurzban, & DeScioli, 2013) demonstrates that there appear to be three distinct types of disgust: *pathogen*, *sexual*, and *moral* disgust. These different types of disgust are distinguished by the types of information they take as input, their information-processing algorithms, the behavioral outputs they produce, and their distinct patterns of relationships with other psychological constructs (Tybur et al., 2013).

Evidence of a sex difference in moral disgust is equivocal, with some studies finding no difference between men and women and others finding a statistically significant but small difference (Al-Shawaf et al., 2014; Tybur et al., 2009). By contrast, research clearly shows a replicable sex difference in pathogen disgust (Al-Shawaf et al., 2014; Tybur, Bryan, Lieberman, Hooper, & Merriman, 2011; Tybur et al., 2009), and a large, robust sex difference in sexual disgust (Al-Shawaf et al., 2014;

Tybur et al., 2011; Tybur et al., 2009). Consequently, we focus on sexual and pathogen disgust in this article, outlining possible explanations for the sex difference in these two domains.

Sex Differences in Sexual Disgust

There is a large and robust sex difference in sexual disgust, with effect sizes in the range of .60 to 1.54 (e.g., Al-Shawaf et al., 2014; Fleischman, 2014; Tybur et al., 2009). In this section we propose four evolutionary explanations for this sex difference, each with its own selection-based logic. Each is driven by an analysis of sex differences in the costs and benefits of the consequences of poor mating decisions.

The parental investment hypothesis. Women's higher levels of sexual disgust may be partly attributable to women's much larger minimum obligatory parental investment (Fleischman, 2014). In species characterized by a sex difference in minimum obligatory parental investment, the higher-investing sex evolves to be choosier and more discriminating in their mating decisions, whereas the sex that invests less evolves to be less choosy and more competitive over the valuable reproductive resources of the higher investing sex (Trivers, 1972; see also Kokko & Johnstone, 2002; Kokko & Monaghan, 2001). This is because members of the higher investing sex incur greater costs, on average, from injudicious mating decisions. This logic successfully predicts sex differences in choosiness across a wide variety of animal species (Alcock, 2009). This reasoning also makes the key prediction that in "sex-role reversed" species (those characterized by greater male parental investment), males will be choosier and females will be more competitive—a prediction that is strongly validated by species across the animal kingdom (Alcock, 2009; Buss, 2015; Dawkins, 1976; Trivers, 1972).

The same underlying logic may explain the difference between males and females in sexual disgust. In humans, as in other mammals, females are characterized by greater minimum obligatory parental investment than males. This has led to the evolution of female choosiness and discriminativeness, particularly in short-term sexual contexts (Buss, 2003; Symons, 1979; Trivers, 1972). Lower thresholds for sexual disgust facilitate female choosiness by reducing the likelihood of injudicious mating decisions. *Reduced* sexual disgust among males, by contrast, appears to increase the pool of prospective mates and promote short-term mating behavior (Al-Shawaf et al., 2014). This strategy would be much less beneficial for women, as it would undermine female choosiness.

The sex difference in minimum obligatory parental investment may also explain the sex difference in aversion to incest (women show a stronger aversion to incest than men). A sex difference in aversion to incest follows logically from the sex difference in parental investment: injudicious mating decisions carry greater costs for women than they do for men (Haig, 1999; Lieberman, Tooby, & Cosmides, 2003). Research verifies this prediction: women are indeed more incest-averse than are men (Fessler & Navarrete, 2004; Haig, 1999) and

experience greater disgust in response to imagining sexual acts with their siblings (Lieberman et al., 2007). This hypothesis suggests the predictions that (a) women's heightened sexual disgust will be especially marked in short-term sexual contexts, and less so in long-term contexts in which both sexes invest heavily and hence are roughly equally choosy; (b) mating opportunities will reduce men's disgust more than women's (there is a caveat here: men already have lower dispositional disgust, so they may not experience a stronger facultative reduction on top of their already-lower baseline); and (c) short-term mating primes will be more effective than long-term mating primes at reducing male disgust.

The sexually transmitted infections (STIs) hypothesis.

Parasites have exerted strong selective pressures on humans throughout our evolution (Perry, 2014). Some of the most successful parasites are those that transmit themselves through sexual contact, including the viruses and bacteria that cause syphilis, herpes, gonorrhea, chlamydia, and AIDS. Some of these can stay alive but dormant in our bodies for years or decades, successfully avoiding the attacks of the immune system (Ewald, 2000). Sexually transmitted infections take a hefty toll on human reproductive fitness around the world (e.g., Piot, Bartos, Ghys, Walker, & Schwartländer, 2001), a situation that was likely much worse before the advent of condoms, improved hygiene, and antibiotics.

Relative to men, women are at heightened risk of contracting sexually transmitted infections (Centers for Disease Control and Prevention, 2008; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, 2011; see also Thrall, Antonovics, & Dobson, 2000). Despite the fact that women are more likely to get tested for sexually transmitted infections, refuse to engage in sexual intercourse out of fear of contracting a sexually transmitted disease, and are less likely to consent to casual sex, they are *still* more likely to contract an STI than are men (Seth et al., 2012). Indeed, for a given sex act, the average likelihood of contracting a sexually transmitted infection is higher for women than for men (American Sexual Health Association, 2016; Baggaley, White, & Boily, 2010; Boily et al., 2009). This may be because the female reproductive system provides a more hospitable environment for parasites than the male reproductive system (American Sexual Health Association, 2016). Whatever the cause, the consequence is that women are at greater risk of contracting an STI than are men from the very same sex act.

Women's greater vulnerability is amplified by an asymmetry in the *magnitude* of the costs once an infection has been contracted. STIs often impose heavier costs on women than on men. For example, HPV is largely harmless in men, but is a major cause of cervical cancer in women (Walboomers et al., 1999). According to the STI hypothesis, women's greater likelihood of contracting an STI—together with the greater costs that these STIs can inflict on women—created selection pressures for greater sexual disgust among women (Fleischman, 2014).

Several testable predictions follow. One is that experimentally exposing men and women to images of sexually

transmitted diseases will induce a stronger disgust response among women than men. Alternatively—or additionally—such stimuli may induce a greater *decrease* in mating interest among women relative to men. A third prediction is that potential cues to an STI in a potential sex partner, such as open sores and lesions, will disgust women more than men, and trigger behavioral avoidance of sex. A fourth prediction is that strong evidence of STIs may trigger physiological reactions in women that make sex less likely to occur, such as vaginismus. A fifth is that women will pay more attention to, and be more vigilant about, inspecting potential sex partners for any cues to STIs.

The rape avoidance hypothesis. The vast majority of sexual coercion victims are women (Bachman, 1994; Rennison, 2002; Tjaden & Thoennes, 1998, 2006). Rape and sexual coercion circumvent female choice—a critical element of consensual mating—and impose large fitness costs on women (Darwin, 1859; McKibbin & Shackelford, 2011; Trivers, 1972). It would be astonishing if selection had not produced any defenses against such a hugely costly assault on female choice.

Evidence is not yet conclusive, but studies have uncovered a number of features of female psychology that appear to be designed to reduce the likelihood of sexual assault. These include a heightened sensitivity to cues of male sexual coerciveness when ovulating (Garver-Apgar, Gangestad, & Simpson, 2007), avoidance of dangerous places and risky behavior when ovulating (Bröder & Hohmann, 2003; Chavanne & Gallup, 1998), selecting mates as “bodyguards,” enlisting coalitional allies for deterrence, and error management biases to avoid proximity and contact with strange men (see Buss, 2015, for summaries of hypotheses and evidence).

The rape avoidance hypothesis of disgust suggests that high levels of sexual disgust serve as an additional barrier in mate choice, reducing the likelihood of exposing oneself to or consorting with dangerous men or men who are likely to force themselves on women.

This hypothesis suggests that women may exhibit sexual disgust toward men who pose a sexual coercion threat. This can be tested empirically by investigating whether women are able to detect the threat level posed by different men (see Garver-Apgar et al., 2007), and whether they react with sexual disgust when they do detect a threat. If women do exhibit such psychological capacities, it will be especially interesting to see which cues women use in marking men as sexual threats. Testable predictions include: (a) unfamiliar men will be more likely to evoke sexual disgust than familiar men; (b) aggressive men will be more likely to evoke sexual disgust than friendly men; (c) women at higher risk of being victimized will be especially likely to exhibit sexual disgust; and (d) ovulating women will exhibit higher levels of sexual disgust than nonovulating women toward undesired mates.

The reputational damage hypothesis. Reputation may have also played a role in the evolution of heightened female sexual disgust. Humans are an intensely social species in which

reputation plays a critical role (Emler, 1990; Fehr, 2004). Sexual behavior has an important impact on reputation in human social groups (Buss, 2003; Meston & Buss, 2007), with issues of promiscuity and sexual fidelity being of great interest to males and females alike (e.g., Buss & Schmitt, 1993). Theory and evidence point to an important sex difference: women suffer much greater reputational damage as a result of being viewed as promiscuous, sexually unfaithful, or interested in atypical sexual behavior (Gallup, O'Brien, White, & Wilson, 2009). Research suggests that reputational damage, especially reputational damage related to sexual fidelity and promiscuity, is a central concern among women (Campbell, 1995), an important feature of women's competitor derogation tactics (Buss & Dedden, 1990), and can have a major impact on women's mate value (Buss, 2003). Women who have suffered reputational damage as a consequence of promiscuity or sexual infidelity may face difficulty finding long-term mates, especially ones of high mate value (Buss, 2003).

There is a well-established double standard in this domain: women suffer more severe reputational damage as a consequence of promiscuity or sexual infidelity, whereas men suffer less and sometimes even experience an increase in social status as a consequence of engaging in uncommitted sex with multiple partners (e.g., see Gallup et al., 2009). According to the reputational damage hypothesis, the stark sex difference in the reputational consequences of sexually promiscuous behavior set up selective pressures for the evolution of greater sexual disgust among women compared to men.

Having and communicating high levels of sexual disgust may be an effective way of conveying to others in your social group that you are unlikely to be promiscuous or sexually deviant. Researchers can test this hypothesis by: (a) investigating whether the cognitive salience of reputational concerns affects women's sexual disgust, and whether it does so more than men's; (b) testing whether women report higher levels of sexual disgust in the presence of an audience relative to when they are alone; (c) assessing whether women exhibit heightened sexual disgust when they feel that their sexual reputation is being examined; and (d) assessing third-party perceptions of the promiscuousness and sexual fidelity of women who vary in their self-reported levels of sexual disgust.

Sex Differences in Sexual Disgust: A Summary

In sum, there are at least four theoretically plausible, non-mutually-exclusive factors driving the evolution of women's heightened sexual disgust relative to men: (a) greater minimum obligatory parental investment (*the parental investment hypothesis*), (b) higher likelihood and greater costs of contracting STIs (*the sexually transmitted infections hypothesis*), (c) defense against rape and sexual coercion (*the rape avoidance hypothesis*), and (d) sex differences in reputational damage as a consequence of promiscuous or deviant sexual behavior (*the reputational damage hypothesis*).

Sex Differences in Pathogen Disgust

The sex difference in sexual disgust is paralleled by a less pronounced—but still robust—sex difference in pathogen disgust. In this section we present six distinct possible explanations for women's more powerful pathogen disgust.

The “mothers matter more” hypothesis. A gene's-eye selectionist perspective reminds us that individual organisms are the vehicles that genes use to propagate themselves into the next generation (Dawkins, 1976; Hamilton, 1964). From this perspective, maternal vehicles are arguably more valuable than paternal vehicles in ensuring the long-term propagation of the genes residing in the bodies of their offspring. Among humans, fathers have an important impact on offspring survival (Geary, 2000; Hill & Hurtado, 1996; Mackey & Immerman, 2000), but mothers are even more critical in ensuring the health and survival of offspring (Sear & Mace, 2008). On average, mothers tend to be more dedicated to parenting than fathers (Barash & Lipton, 1997; Hames, 1988; Hewlett, 1991), possess a more sophisticated suite of psychological adaptations for parenting (Babchuk, Hames, & Thompson, 1985; Hampson, van Anders, & Mullin, 2006; Hess, 1975; Taylor et al., 2000), and spend more time holding and caring for their offspring (Barash & Lipton, 1997; Hames, 1988). If mothers matter more to the health and survival of offspring than do fathers, then from a genic perspective the male vehicle is more expendable than the female vehicle with respect to the long-term replication of genes across generations. Selection will therefore act more intensely on female psychology to avoid harm because of the greater impact of mothers on offspring health and viability (Sear & Mace, 2008). There would have consequently been stronger selective pressures on women to be risk-averse and to protect life and limb—and women are indeed more risk-averse than men in a variety of domains (Campbell, 1999; Cross, Copping, & Campbell, 2011; Fischer & Hills, 2012). The logic underlying this general evolutionary principle should apply equally to disease avoidance.

The direct contagion hypothesis. A related but distinct factor driving the evolution of heightened pathogen disgust among women has to do with the dangers of transmitting diseases to one's offspring. Ancestral women would have been more likely than men to transmit infections to their offspring and other young kin. As a result, pathogens and the diseases they cause would have taken a larger toll on women's than men's fitness.

Why would ancestral women have had a greater likelihood than men of transmitting infectious diseases to their offspring? First, ancestral women faced the adaptive problems of gestation and lactation, both characterized by an intimate physiological relationship with their offspring. These intimate conditions raise the likelihood of contagion, and they apply uniquely to women. Second, even after babies are born and weaned, women cross-culturally spend much more time in physical contact with their children than do men, further raising the likelihood of contagion (Barash & Lipton, 1997; Curtis & Biran, 2001; Fessler et al., 2004; Hewlett, 1991). This is true for both

mothers and grandmothers (Sear & Mace, 2008). This means that at every stage of early life—fetus, infant, and child—ancestral women faced a higher probability than men of passing on their infections to their offspring.

Because ancestral women faced this adaptive problem to a greater extent than did men, pathogen-avoidance selection pressures would have been stronger for women than for men, favouring the evolution of higher levels of disgust. Women who were more easily disgusted were probably less likely to contract an infection (see Stevenson, Case, & Oaten, 2009) and consequently less likely to pass on this infection on to their offspring.

The hypothesis that women's greater disgust sensitivity is driven partly by their greater ancestral likelihood of infecting offspring can be tested by putting participants in parenting scenarios and then assessing change in disgust sensitivity or pathogen avoidance. This hypothesis predicts that (a) parenting contexts will cause increased pathogen avoidance among women, (b) this shift in pathogen-avoidance will be greater among women than among men, and (c) mothers will be more pathogen-cautious when their babies are present compared to when they are absent, but (d) this heightened disgust will not apply to pathogens emanating from the offspring themselves (see e.g., Prokop & Fančovičová, 2016, for evidence that mothers have lower disgust sensitivity than childless women).

The idea that women who contracted infections would have risked harming both themselves and their offspring suggests two additional hypotheses: that men may have adaptations for promoting pathogen avoidance in their mates, and that males may *dislike* women with especially low levels of disgust. These hypotheses await empirical tests.

The teaching and modeling hypothesis. Apart from the issue of directly transmitting infections to offspring, parents face the dual adaptive problems of keeping children away from pathogens and teaching children effective disease-avoidance behavior. This problem is especially acute in early childhood because young children have underdeveloped immune systems and are especially vulnerable to infection (e.g., see El-Madhun, Cox, Søreide, Olofsson, & Haaheim, 1998).

Because mothers worldwide spend more time than fathers teaching children, showing by example, and guiding and directing behavior (Barash & Lipton, 1997; Hames, 1988; Hewlett, 1991), ancestral women likely had a greater impact than men on their children's prophylactic behavior and disease status. Ancestral women would have therefore benefited from elevated disgust in their prominent role in keeping children away from disease. To paraphrase a prominent disgust researcher, ancestral women had to be disgusted for two (Curtis et al., 2011).

The scope of this parenting-and-childrearing hypothesis extends beyond one's own offspring. The anthropological and ethnographic record indicates that allomothering is widespread among humans (Hrdy, 2007), and many genetic relatives play a part in taking care of young kin. These include the child's father, aunts, uncles, grandparents, and siblings (Hrdy, 2007; Sear & Mace, 2008). This investment in kin is characterized by the same sex difference that characterizes direct parenting, with female kin playing a more direct role in childcare and investing

more in young offspring (Sear & Mace, 2008). As with direct parenting, elevated female disgust may have helped ancestral women solve the adaptive problem of keeping young kin away from dangerous pathogens.

In sum, ancestral women would have had a greater impact on protecting young kin from disease in both direct parenting and allomothering. The evolution of elevated pathogen disgust among women may be, in part, a solution to the adaptive problems of guiding children away from sources of infection and facilitating children's acquisition of appropriate prophylactic behavior through imitation and observational learning (see Stevenson, Oaten, Case, Repacholi, & Wagland, 2010). This hypothesis suggests the prediction that women will experience heightened disgust at pathogenic stimuli when their offspring are present compared to when they are alone, and will exhibit more pronounced facial expressions of disgust in front of their children compared to when they are alone or accompanied by other adults.

The food preparation hypothesis. Food cleaning and food preparation also may have played a role in the evolution of elevated female disgust. The food we eat is a major source of pathogens and parasites (Newell et al., 2010). This is especially true of meat, which is laden with bacteria (Fessler & Navarrete, 2003; Rozin, 2004). In most hunter-gatherer and hunter-horticultural societies, women play a greater role in food cleaning, cooking, and preparation (e.g., Draper, 1975; Gurven, Winking, Kaplan, von Rueden, & McAllister, 2009; Johnson, 1975). Ancestral women could therefore have benefited from heightened disgust sensitivity if it motivated more hygienic food cleaning or food preparation. Elevated disgust and greater prudence with contaminated food would have paid fitness dividends in lower disease rates for women, their mates, their offspring, and other genetic relatives. Because of men's lesser impact on food hygiene and food preparation (Gurven et al., 2009; Halperin, 1980), this particular selective pressure would have been weaker on males. Elevated female disgust sensitivity may be, in part, the outcome of the sex-differentiated adaptive problem of food preparation.

The male mating hypothesis. A fifth potential explanation for the sex difference in pathogen disgust involves the benefits of reduced male disgust in the domain of mating. First, theory and evidence suggest that reduced sexual disgust helps solve the adaptive problem of sexual variety and facilitates the implementation of a short-term mating strategy (Al-Shawaf et al., 2014). The same may be true of pathogen disgust—reduced levels of pathogen disgust may increase the number of potential mates one is willing to have sex with, as well as the number of contexts in which one is willing to have sex. In this way, lower levels of pathogen disgust may facilitate intercourse with a larger number of partners, a mating strategy that benefits men's reproductive success more than it does women's (Trivers, 1972).

Second, evidence suggests that women possess mate preferences for signs of health and immunological robustness,

especially in short-term mating (Gangestad & Thornhill, 1997; Thornhill & Møller, 1997). Many of these health- and immunity-linked cues are morphological, such as facial symmetry and facial and bodily masculinity (Gangestad & Thornhill, 1997; Grammer & Thornhill, 1994; Shackelford & Larsen, 1997; but see Harris, 2013, and Wood, Kressel, Joshi, & Louie, 2014, for a dissenting view; and Boothroyd, Scott, Gray, Coombes, & Pound, 2013, for a mixed-evidence review). However, selection should have also favored adaptations to scrutinize *behavioral* indicators of health and immune function (e.g., Byers, Hebets, & Podos, 2010; Byers, Moodie, & Hall, 1994; Kotiaho, Alatalo, Mappes, & Parri, 1996) and regulate mating attraction accordingly.

Men's levels of disgust may reveal important information about their immunological robustness (Fessler et al., 2004). A willingness to approach contaminants may be an honest behavioral signal of a man's immune strength, whereas overcautiousness around pathogens may be a cue to poor genetic quality and communicate inferior immune function (Fessler et al., 2004). If disgust levels are an important cue to immunological robustness (Al-Shawaf, Lewis, et al., 2015; Fessler et al., 2004) and immunological robustness is an important criterion in women's mate selection, then men may down-regulate their expression of disgust in front of potential mates to convey a healthier, stronger immune system¹ (see Al-Shawaf, Conroy-Beam, Asao, & Buss, 2015; Al-Shawaf, Lewis, et al., 2015; Fessler et al., 2004; Fleischman, 2014). Researchers can test this hypothesis by assessing whether mating primes are more effective at reducing male disgust than female disgust. This hypothesis also suggests that men will show less disgust in front of an audience of attractive reproductive-aged women relative to an audience of men, children, or postreproductive women, as well as conditions in which no audience is present.

Alternatively, it is possible that men do not have genuinely lower levels of disgust, but may simply suppress their disgust in front of the opposite sex. Such behavior might be driven by mating motivations (see above) or by reputational concerns. However, the facts that (a) behavioral and observational studies also reveal greater disgust among women than men (e.g., Oaten et al., 2009; Porzig-Drummond et al., 2009; Rozin et al., 1999), and (b) women outperform men even when it comes to *recognizing* disgust in the facial expressions of others (Kret & De Gelder, 2012; Montagne, Kessels, Frigerio, de Haan, & Perrett, 2005; Rotter & Rotter, 1988), suggest that men's ostensibly lower disgust is unlikely to be *entirely* attributable to suppression. We therefore think it most likely that women's higher disgust is due to both a higher female baseline *and* male suppression. In other words, women likely have higher baseline disgust sensitivity to begin with, and in addition, men likely suppress their disgust in certain predictable circumstances such as the mating context described before. We are currently testing this hypothesis in a series of cross-cultural experiments.

The hunting and warfare hypothesis. Historically, hunting and warfare have been predominantly male activities (Ghiglieri,

1999; Silverman, Choi, & Peters, 2007; Tooby & DeVore, 1987). These activities are associated with high risk of exposure to pathogen vectors: dead bodies, severed limbs, dangerous infections, blood loss, and open wounds. This suggests that during human evolution, selective pressures would have operated against hypersensitive disgust mechanisms in men. Low disgust thresholds in men would have interfered with their ability to hunt, combat enemies, help wounded allies, and transport bloody and injured bodies (human and animal) back to camp. The hunting and warfare hypothesis suggests that these selective pressures were partly responsible for raising male disgust thresholds—especially to blood, open wounds, and severely injured bodies. Because food preparation seems to have been a female-dominated activity (e.g., Draper, 1975; Gurven et al., 2009; Johnson, 1975), this hypothesis would predict a larger sex difference in disgust at *human* blood, wounds, and dead bodies than for the same stimuli in nonhuman animals. This hypothesis also predicts that (a) activating men's coalitional hunting or war psychology should reduce their disgust sensitivity, (b) this effect should apply more strongly to hunting- and war-related disgust stimuli relative to other disgust stimuli, and (c) this effect should apply more strongly to men than it does to women.

In summary, we have proposed six hypotheses for the evolution of elevated female pathogen disgust: (a) reduced risk-taking among women because female vehicles are more critical than male vehicles to the long-term propagation of the genes residing in their offspring's bodies; (b) greater female likelihood of directly transmitting infections to offspring; (c) a greater role for women in keeping children away from pathogens and teaching them effective disease-avoidance principles; (d) a greater role for ancestral women in food cleaning and food preparation; (e) lower levels of disgust among men in order to convey immune strength and facilitate short-term mating; and (f) higher male thresholds for disgust related to blood, injury, and death because of selective pressures related to hunting and warfare. We have outlined a number of testable predictions based on each, and future research will be needed to adjudicate between them. These hypotheses are not mutually exclusive, and each may be partly responsible for the sex difference in pathogen disgust. If future research supports more than one of these hypotheses, it may also allow assays of the relative strength and importance of each in explaining variance in disgust sensitivity.

Some Novel Hypotheses About Sex Differences in Disgust

A contemporary evolutionary psychological approach to the emotions suggests that they are *coordinating mechanisms*—information-processing programs that evolved to coordinate the activity of a variety of psychological and physiological mechanisms in the service of solving an adaptive problem (Al-Shawaf et al., 2015; Cosmides & Tooby, 2000; Tooby & Cosmides, 1990, 2008). For example, fear regulates programs in order to avoid danger, sexual arousal orchestrates programs in preparation for a valuable sexual opportunity, and pathogen disgust coordinates mechanisms in the service of avoiding

infection (Al-Shawaf, Conroy-Beam, et al., 2015; Al-Shawaf & Lewis, 2017).

This perspective suggests that emotions coordinate many different psychological and physiological programs, including perception, attention, memory, specialized inference mechanisms, communication and expression, and behavior (Cosmides & Tooby, 2000; Tooby & Cosmides, 1990). One of the strengths of this approach is its ability to generate theoretically anchored *a priori* hypotheses about how each emotion is expected to coordinate these various mechanisms (for examples and discussion, see Al-Shawaf et al., 2015; Al-Shawaf & Lewis, 2017; Al-Shawaf et al., 2014). Here, we offer novel hypotheses about previously unexplored sex differences in disgust attention, memory, communication, and specialized inference mechanisms.

In the realm of communication and emotion expression, we have already suggested that men may be more likely to downplay their disgust than women, and that they may be more likely to do this in the presence of the opposite sex. Here we suggest two more novel predictions. First, women will be more likely than men to exaggerate their disgust responses (for educational purposes) in front of their offspring. And second, because women are more easily disgusted than are men, men will be more likely to derogate their rivals' hygiene habits during mate competition. Interestingly, existing data offer mixed evidence regarding this latter hypothesis (Buss & Dedden, 1990).

We also suggest that women will exhibit greater attention and memory for disgust- and hygiene-related matters. This may include paying more attention and more strongly encoding in memory who gets sick often, who was recently observed to be sick, who smells off-putting, and who has poor hygiene. We suggest women will exhibit superior attention and memory for these topics for the purpose of protecting themselves, avoiding such individuals as mates, and avoiding exposing their children to such individuals (as allmothers, for example).

Finally, in the domain of specialized inference mechanisms, recent work suggests that disgust operates according to the logic of error management theory (Haselton & Buss, 2000; Haselton & Nettle, 2006). Broadly, error management theory proposes that when (a) a species recurrently faces a decision-making task, and (b) the decision-making task is characterized by an asymmetry in the costs of the two types of error (i.e., one type of error is more costly than the other), the species in question tends to evolve a decision-making system that is *adaptively biased* in the direction of the less costly error. And because the cost of failing to detect pathogens is much greater than the cost of erroneously "detecting" pathogens where none exist, the information-processing rules of the disgust system have evolved to be functionally biased in the direction of false positives; that is, to "detect" pathogen threats where none really exist (Park, Faulkner, & Schaller, 2003; Park, Schaller, & Crandall, 2007). For example, despite their non-contagious nature, many people are disgusted by obesity, birthmarks, and wounds caused by burns (Park et al., 2003; Park et al., 2007). We suggest that women may be more prone to false positives in these domains, reacting with disgust to noninfectious atypical anatomical features at a higher rate

than men. Note that this does not necessarily mean that women will be more likely to stigmatize these groups, as there may be countervailing forces pulling in the opposite direction (e.g., greater compassion and empathy among women than men; Baron-Cohen & Wheelwright, 2004; Hoffman, 1977).

We hope that, in addition to the novel hypotheses that we advanced in the preceding sections, these additional new hypotheses about disgust attention, memory, communication, and specialized inference inspire researchers to test new ideas about disgust and the many psychological and physiological processes this emotion likely affects.

Conclusions and Future Directions

This article has tackled a basic theoretical question in disgust research: why are women more easily disgusted than men? We considered the question separately for sexual disgust and pathogen disgust, offering a number of distinct hypotheses for each.

According to the evolutionary metatheory of sex differences, women and men are hypothesized to differ in those domains in which they have recurrently faced different adaptive problems over the course of human evolutionary history (Buss, 1995). Each of the 10 hypotheses we have proposed posits a sex difference in adaptive problems faced by men and women. For sexual disgust, these include sex-based asymmetries in the costs of making poor short-term mating decisions (*the parental investment hypothesis*), sex differences in the risks and costs of STIs (*the STI hypothesis*), asymmetries in the likelihood and costs of sexual assault (*the rape avoidance hypothesis*), and disparities in reputational damage from engaging in short-term sex (*the reputational damage hypothesis*). For pathogen disgust, these include the greater dependence of genetic vehicles on maternal investment (*the “mothers matter more” hypothesis*), the greater risk of mother–offspring contagion than father–offspring contagion (*the direct contagion hypothesis*), the greater role of mothers relative to fathers in protecting offspring from pathogens and teaching them appropriate disgust behavior (*the teaching and modeling hypothesis*), the greater risk of food contamination due to asymmetries in effort allocated to food preparation (*the food preparation hypothesis*), stronger selective pressures for reduced disgust in males to facilitate mating (*the male mating hypothesis*), and higher disgust thresholds for blood, injury, and dead bodies among males because of selective pressures related to hunting and warfare (*the hunting and warfare hypothesis*).

We also put forth several novel hypotheses about sex differences in disgust attention, memory, communication, and specialized inference mechanisms. We hope these inspire researchers to test new ideas about disgust and the many psychological and physiological processes that underpin this complex emotion.

The evolutionary metatheory of sex differences also contends that men and women will be *similar* in all domains in which they have faced similar adaptive problems. This framework provides an additional suite of tests—that sex differences in sexual and pathogen disgust should be attenuated in all domains in which the sexes have faced similar adaptive

problems. In addition to explaining sex differences in pathogen and sexual disgust, a comprehensive theory of sex differences in disgust should also successfully predict and explain domains in which sex differences are attenuated or absent.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Note

- 1 However, we would not expect women to be attracted to men who are so careless around pathogens that they get sick and risk infecting women. Too much and too little disgust can both be maladaptive, and, we think, unattractive to potential mates. We therefore expect an inverted U-shaped relationship between men’s disgust and women’s liking rather than a simple linear relationship.

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