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Correlational and Experimental Analyses of the Relation Between Disgust and Sexual Arousal

Arthur R. Andrews III, Ph.D., Travis Crone, Ph.D., Cecilia B. Cholka, M.A., Theodore V. Cooper, Ph.D., and Ana J. Bridges, Ph.D.

In humans, sexual contact may provoke numerous physiological and emotional responses, such as excitement and nervous tension. The ways humans react to sex are as numerous and diverse as the methods they use to extract enjoyment from intimate contact. The emotions evoked by sex, however, are not necessarily and uniformly positive. Rather, negative reactions are quite common (Goodson, McCormick, & Evans, 2000; Koukounas & McCabe, 1997). Feelings of disgust stand as possibly the most frequent of negative reactions to sexual stimuli (Goodson et al., 2000; Koukounas & McCabe, 1997). Disgust responses to erotic stimuli, such as sexually explicit videos, have been noted for decades, especially among people with sexual functioning difficulties (Angyal, 1942). Yet, theoretical work has only recently begun to explore the specific relations between disgust and sexual arousal. Empirical work to date points to a strong and negative relation between the two variables, with important implications for understanding sexual functioning difficulties (for a review, see de Jong, van Overveld, & Borg, 2013).

Disgust and Sex

In one of the first thorough theoretical works exploring disgust and sex, de Jong and colleagues (2009) proposed an inhibitory role of disgust on sexual functioning broadly. They suggested that disgust interrupts appropriate sexual responding, largely by inhibiting the first stages of sexual response: sexual arousal and desire (de Jong, van Lankveld, Elgersma, & Borg, 2010). The disruption of early stages of sexual responding makes performance at later stages, including orgasm, virtually impossible (Basson, 2000; de Jong et al., 2009; Georgiadis & Kringelbach, 2012; Giles & McCabe, 2009; Hayes, 2011).

In addition to inhibition of sexual arousal, de Jong and colleagues (2009) posited another sexually disruptive role for disgust. Specifically, disgust, like anxiety, tends to motivate avoidance and rejection (e.g., spitting out bad tasting food). Disgust-motivated avoidance of stimuli in other contexts has taken the form of limiting physical contact with the stimulus, limiting attention to the stimulus (e.g., not looking at it), or directly refusing contact with the stimulus (for a review, see Olatunji & McKay, 2008). In the sexual context, avoidance or rejection of stimuli may take the form of averting physical contact or discussions of sex with partners, limiting attention to sexual stimuli during sexual contact (e.g., rushing through

sexual contact in order to “get it over with”), reducing the number of sexual encounters initiated by the individual, or overtly refusing sexual contact.

Correlational research of women with sexual dysfunctions, particularly vaginismus, has found preliminary support for disgust-based rejection of sexual stimuli (Borg et al., 2010; Borg et al., 2011). In the Diagnostic and Statistical Manual of Psychiatric Disorders, fourth edition, text revision (DSM-IV-TR; APA, 2000) vaginismus is classified as a sexual dysfunction in which pelvic floor muscles contract, preventing penetration or making it painful to endure. Among women with this disorder, disgust propensity, the trait-like degree to which a person responds to disgust stimuli, is higher than that of women without vaginismus (Borg et al., 2010). Even when compared to women with other sexual dysfunctions, women with vaginismus report higher disgust propensity (Borg et al., 2010). Further, women with vaginismus tend to associate disgust-relevant words more readily with sexual words than do women without any reported sexual dysfunction or women with other sexual dysfunctions (Borg et al., 2011).

Nature of Disgust

In order to fully understand the relation between disgust and sex, it is first important to distinguish between different types of disgust. As with other emotions, empirical and theoretical works have proposed both visceral state-like and enduring trait-like qualities of disgust (for a review, see Olatunji & McKay, 2008). In all forms, disgust produces significant avoidance and escape tendencies (Olatunji & McKay, 2008), and avoidance may even involve limiting visual contact with stimuli (e.g., Armstrong, McClenahan, Klittle, & Olatunji, 2014). Both trait-like qualities of disgust and state disgust have been proposed as primarily functioning to prevent contamination (Rozin & Fallon, 1987). Though terminology regarding trait-like qualities of disgust have varied somewhat, two trait-like qualities have typically been identified—disgust propensity and disgust sensitivity (Goetz, Cougle, & Lee, 2014; Olatunji, Cisler, Deacon, Connolly, & Lohr, 2007; van Overveld, de Jong & Peters, 2010; van Overveld, de Jong, Peters, Cavanaugh, & Davey, 2006). A third ruminative factor has also recently been suggested (Goetz et al., 2014). Disgust propensity refers to the degree to which a person experiences disgust in the presence of specific disgust-eliciting stimuli, while disgust sensitivity refers to how bothered a person is by experiencing the emotion of disgust (e.g., van Overveld et al., 2006). The majority of theoretical and empirical work on disgust and sex has addressed disgust propensity as defined here (importantly, some authors use the term disgust sensitivity when discussing the degree of disgust elicited by a stimulus). We therefore focus on disgust propensity for the purposes of this study.

In research examining disgust propensity, the stimuli that induce disgust are numerous and varied. Empirical work has suggested that disgust-eliciting stimuli may be grouped into different types or categories, frequently referred to as domains (Haidt et al., 1994; Olatunji et al., 2007; Sandín, Chorot, Santed, Valiente, Olmedo, & Campagne, 2013; Tybur, Lieberman, & Griskevicius, 2009). For instance, Tybur et al. (2009) group disgust-eliciting stimuli into pathogen, moral, and sexual domains, though these authors refer to the domains as domains of disgust sensitivity. Sandín and colleagues (2013) found seven domains of

disgust in a Spanish sample (hygiene, moral, sexual, body transgression, small-animals, atypical food, and disease). The separation of these domains appears crucial, as disgust propensity varies greatly between each domain (Haidt et al., 1994; Olatunji, Haidt, McKay, & David, 2008; Olatunji et al., 2007; Rozin, Haidt, McCauley, Dunlop, & Ashmore, 1999; Tybur et al., 2009). A person may react strongly with disgust in response to stimuli from one domain, yet experience very little disgust in response to stimuli from another. Further, when induced in a laboratory setting, disgust-eliciting stimuli from different domains activate differing, although related, neurological patterns (Borg, de Jong, Renken, & Giorgiadis, 2013; Moll et al., 2005; Wright, He, Shapira, Goodman, & Yu, 2004).

Despite evidence distinguishing between domains of disgust propensity, the exact number of domains that comprise disgust has varied in the empirical literature. For example, using questionnaire-based methods, Haidt and colleagues (1994) found support for seven distinct domains (food, animals, body products, sex, envelope violation, death, and hygiene). Olatunji and colleagues (2007), using the same item pool, suggested three domains might be more appropriate (moral, animal reminder, and core). As mentioned above, Tybur and colleagues (2009) found support for three disgust propensity domains (pathogen, sexual, and moral) and provided hypotheses as to the evolutionary benefit for the development of each domain.

Despite a lack of consensus regarding the domains or categories of stimuli that elicit disgust, three important observations can be made. First, nearly all measures of disgust propensity find sexual disgust to be its own domain (e.g., Haidt et al., 1994; Sandín et al., 2013; Tybur et al., 2009). Second, women tend to endorse greater disgust sensitivity and propensity than men across all domains and this discrepancy is greater for the sexual domain (Tybur, Bryan, Lieberman, Hooper, & Marriman, 2011; Tybur et al., 2009). Third, theoretical and empirical work suggests both pathogen and sexual disgust propensity domains have important implications for sexual behavior. We review these next.

Disgust and Sex: Mutual Inhibition

The pathogen and sexual disgust propensity domains have been proposed to inhibit sexual arousal in two different ways. Tybur and colleagues (2009) proposed that disgust responding to specific sexual acts poses an evolutionary benefit by reducing sex behaviors that are reproductively inefficient (e.g., anal sex) or that harm evolutionary fitness of offspring (e.g., incest). As such, the authors argue a number of sexual acts may readily elicit disgust rather than sexual arousal responses. Subsequent confirmatory factor analyses suggested disgust may be readily associated with a number of sexual acts (Tybur et al., 2009), although many of the sexual acts found to elicit disgust may have little to no bearing on evolutionary fitness (e.g., performing oral sex or hearing two strangers have sex). Nonetheless, sexual stimuli themselves appear to represent a distinct domain of disgust propensity. Disgust elicited by certain sexual stimuli, in turn, may inhibit arousal to other aspects of a sexual encounter.

Pathogen disgust responding may inhibit sexual arousal through other means. Sexual congress requires a person to engage with many potentially infectious materials (e.g., multiple bodily fluids). As a result, sex may require simultaneous interactions with disgust-

and arousal-eliciting stimuli. de Jong and colleagues (2013) propose two potential response cycles: dysfunctional and functional. In both, disgust and sexual arousal are proposed to be mutually inhibitory states. In the sexually functional response cycle, sexual arousal cues (e.g., tactile stimulation of the genitals) are encoded during sexual contact and sexual arousal occurs to a sufficiently high degree to inhibit disgust reactions to other stimuli (e.g., contact with bodily fluids). In the sexually dysfunctional response cycle, disgust responding to pathogen stimuli is too intense for sexual arousal to occur and, consequently, motivates escape and avoidance behaviors. Further, attention to disgust cues may prevent the processing of pertinent sexual arousal stimuli.

Similar to Tybur and colleagues (2009), de Jong and colleagues (2013) propose an evolutionary benefit to the mutual inhibition of disgust and sexual arousal. The majority of evidence cited by de Jong and colleagues in support of an evolutionary hypothesis, however, applies only to women. For example, the authors cite evidence that women display greater disgust propensity during phases of the menstrual cycle where immunological functioning and potential for conception are reduced (e.g., Fleischman & Fessler, 2011), although some evidence suggests that disgust propensity may not relate to immunological changes throughout the menstrual cycle (e.g., Fessler & Navarette, 2003). Further, de Jong and colleagues cite similar evidence that disgust propensity is heightened during the first trimester of pregnancy (e.g., Fessler, Eng, & Navarette, 2005), presumably to enhance the chances of the embryo surviving during a time of pregnancy in which infectious material may pose the most risk. Some evidence also suggests a negative relation between sexual functioning and pathogen disgust propensity, but this evidence has almost exclusively examined the context of vaginal pain difficulties among women of predominately European descent (Borg et al., 2010; Borg et al., 2011). Similarly, recent evidence suggests disgust sensitivity and disgust propensity positively predict orgasm and sexual pain difficulties among women, but not men (Grauvogl et al., 2014).

Conceptualizations of the inhibitory nature of disgust on sexual arousal emphasize psychological aspects of sexual arousal (i.e., appetitive responding and behavioral approach), rather than the physiological (e.g., vasocongestion). This type of arousal might also be termed sexual interest or sexual desire. Nonetheless, state disgust has been conceptualized to reduce behavioral (e.g., avoiding sexual contact), cognitive (e.g., ruminating on disgust-eliciting components of sex), and affective (e.g., low levels of perceived sexual arousal) components of sexual arousal. Fewer proposals have emphasized often measured physiological components of sexual arousal (e.g., genital blood volume). The distinction between different forms of sexual arousal may be particularly important, as psychological and physiological sexual arousal are highly discordant among women, but highly congruent among men (for a review, see Chivers, Seto, Lalumiere, Laan, & Grimbos, 2010). Additionally, anxiety impacts psychological sexual arousal differently for men and women. Similar to the proposed relation between disgust and psychological sexual arousal, anxiety appears to inhibit psychological sexual arousal among women (Pallace & Gorzalka, 1990). Unlike the proposed relation between disgust and sexual arousal, anxiety appears to *enhance* psychological sexual arousal among men, and physiological sexual arousal among both men and women (Barlow, Sackheim, & Beck, 1983; Dutton & Aron, 1974; Hoon,

Wincze, & Hoon, 1977; Pallace & Gorzalka, 1990; Wolchik et al., 1980). Initial correlational evidence suggests a similar relation between the trait-like qualities of disgust and sexual arousal (Grauvogl et al., 2014). Although the study included a relatively small sample ($n_{men} = 19$, $n_{women} = 24$), disgust sensitivity and disgust propensity both correlated positively with psychological and physiological sexual arousal for men. No significant correlation between disgust and sexual variables was found for women. The small sample size and aggregating disgust sensitivity across domains limits the interpretability of these findings. Nevertheless, these results suggest that disgust may not inhibit sexual arousal for men. Further, results suggest examining gender-specific effects is essential to research on sexual arousal and disgust.

Evidence regarding disgust and sexual responding among men is quite limited and has largely focused on the inhibitory effect of sexual arousal on disgust. Specifically, experimental evidence with separate male (Ariely & Loewenstein, 2006) and female (Borg & de Jong, 2012; Stevenson et al., 2011) samples supports the hypothesis that inducing sexual arousal diminishes disgust responding to a variety of disgust-eliciting stimuli. For example, investigators randomly assigned a sample of predominately White college men to either masturbate during study procedures or not (this study was conducted in participants' homes without the experimenter present and participants were provided laptops in order to complete study procedures; Ariely & Loewenstein, 2006). During these procedures, participants were asked how likely they would be to engage in a number of activities including taboo or otherwise unappealing sex practices (e.g., having sex with someone who was sweating, extremely fat, or four decades older than the participant). Men who masturbated during the experimental sessions reported being more likely to engage in the typically disgust-eliciting sexual activities than men who did not. The study provides preliminary evidence for the inhibitory effect of sexual arousal on disgust in the sexual domain.

The inhibitory nature of sexual arousal on subsequent disgust responses has also been demonstrated in women. Borg and de Jong (2012) randomly assigned a sample of female college students living in the Netherlands to view either sexual explicit or neutral videos (Borg & de Jong, 2012). The women then were asked to engage in a series of disgust inducing tasks that utilized stimuli from both pathogen and sexual domains (e.g., touching a condom that appeared used). Women who watched the sexually explicit video rated the activities as less disgusting and engaged in more of the activities across both pathogen and sexual domains than women who did not see sexually explicit videos. In other words, sexual arousal appeared to reduce both subjective state disgust and disgust-induced avoidance from both pathogen and sexual domains. More recently, Lee and colleagues (2014) demonstrated that sexual arousal lowered responses to measures of sexual disgust propensity among women, but not men. A sample of college men and women were asked to perform sexually arousing behavior or physically arousing behavior of their choosing at home. They were then asked to complete the TDDS. Women who completed sexually arousing acts reported lower sexual disgust than women who completed physically arousing acts. Women did not differ between the two conditions across either moral or pathogen disgust propensity. Men did not differ on any scale between the two conditions. This differs from other research in

that it examined the effect of sexual arousal on a trait-like quality of disgust, disgust propensity, which is hypothesized to remain relatively constant. Taken together, the experiment adds to previous literature supporting an inhibitory effect of sexual arousal on disgust, and suggests the effect may be stronger among women than men. Still, experimental evidence has yet to support hypotheses regarding the inhibitory effect of state disgust on sexual arousal or the relation between state disgust and sexual avoidance.

Purpose

The current study sought to experimentally examine the influence of disgust on sexual arousal. This study aimed to improve on previous research regarding disgust and sex in two important ways. First, theoretical works have suggested disgust inhibits sexual arousal and increases avoidance of sexual stimuli (de Jong et al., 2010; de Jong et al., 2013), but the inhibiting role of disgust on sex has yet to be demonstrated empirically. The present study therefore experimentally manipulated participants' disgust, with the hypothesis that disgust induction would inhibit sexual arousal to and increase avoidance of subsequent sexual stimuli. Specifically, in accordance with theoretical proposals we examined the effect of induced pathogen disgust on sexual arousal. The current study also examined the relations between sexual disgust and pathogen disgust propensity, and sexual arousal and behavioral avoidance. Based on evidence that disgust propensity predicts domain-specific behavioral avoidance and subjective disgust (Olatunji et al., 2008), we expected pathogen disgust propensity to moderate the effect of disgust primes. Second, the study experimentally explored the inhibiting effect of disgust and sex among both men and women, in contrast to much of the previous experimental research focused solely on either men (Ariely & Loewenstein, 2006; Stevenson et al., 2011) or women (Borg & de Jong, 2012; Borg et al., 2010; Borg et al., 2011; de Jong et al., 2009). Given that disgust propensity is greater among women (Tybur et al., 2011; Tybur et al., 2009), the majority of theoretical work on the mutual inhibition of disgust and sexual arousal applies exclusively to women (de Jong et al., 2013), and some correlational evidence suggests that sexual arousal may only inhibit disgust responding among women (Lee et al., 2014), we hypothesized the inhibitory role of disgust on sexual arousal would be stronger in women than in men.

Method

Participants

Participants were 306 adults recruited at two large southwestern universities. Two participants did not complete any questionnaires and were excluded from all analyses. Due to the exclusively heterosexual nature of the sexual images used, participants (2.4%; 7 female and 1 male) who reported only being attracted to members of the same sex were excluded from analyses. An additional six participants did not indicate their gender and were also excluded from analyses. Of the remaining 293 participants, mean age was 22.06 years ($SD = 5.71$). The majority of participants ($n = 203$; 69.3%) identified as Hispanic, 39 (13.3%) identified as African American, 28 (9.6%) identified as Anglo American, and 11 (3.8%) identified as multiethnic or multiracial. Two participants (0.7%) did not report race or ethnicity. Most ($n = 206$; 70.3%) were women. The majority of participants ($n = 234$;

79.9%) reported having previously engaged in sexual intercourse. A further description of participant demographics is presented in Table 1.

Procedure

All materials, including informed consent and debriefing, were presented via the internet. Once participants provided informed consent, they were randomly assigned to one of two groups (neutral vs. disgust prime) following a between subjects design. Although the image content differed between the two conditions, the image sequence remained the same. In both conditions, participants were shown 12 pairs of sexually explicit images. In each pair, participants were first shown a priming image (disgust or neutral) for 0.5 seconds. Immediately following each priming image, participants were shown a sexually explicit image. Participants rated how arousing they found each sexual image. Although the timing of the primes was uniform, timing of sexual images was self-paced by participants. Participants' timing—how long they view each sexual image—was recorded by the survey software. The timing of viewing images and the number of image ratings participants avoided were used as the primary indicators of behavioral avoidance. Procedures alternated between disgust primes and sexual arousal images, as opposed to a single disgust induction phase followed by a single sexual arousal phase, in order to more closely resemble the dysfunctional loop in which disgust and sexual stimuli are presented simultaneously (de Jong et al., 2013).

Once participants had rated all images, they completed a series of self-report questionnaires, including the Three Domain Disgust Scale (TDDS; Tybur et al., 2009), and answered demographic questions that asked participants about their race/ethnicity, age, gender, and sexual history. A number of questionnaires not relevant to the current analyses (e.g., measures of relationship goals) were presented between sexual arousal stimuli and the TDDS in attempt to limit the impact of experimental condition on disgust propensity measurement. Previously, sexual arousal has been found to diminish not only state disgust, but also sexual disgust propensity as measured by the TDDS (Lee et al., 2014). After participants completed the questionnaires, they were debriefed, thanked for their time, and provided course credit as compensation.

Materials

Disgust and neutral prime images—Twelve International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999) images⁴ previously demonstrated to elicit disgust (Mikels et al., 2005) were utilized as disgust primes. The images depicted content such as insects, feces, and garbage. Pathogen disgust images were selected because disgust stimuli that inhibit sexual arousal have largely been hypothesized to derive from the pathogen domain (de Jong et al., 2013). We specifically avoided sexual disgust images so that primes were not confounding disgust and sexual arousal. Neutral primes for the disgust control condition included 12 images⁵ from the IAPS that have been demonstrated to elicit neutral

⁴IAPS images numbered 1945, 7359, 7380, 9290, 9300, 9301, 9320, 9330, 9373, 9390, 9570, and 9830 were used as disgust primes.

⁵IAPS images numbered 2980, 5120, 5130, 5390, 5500, 5731, 5740, 7000, 7002, 7004, 7006, and 7009 were used as neutral primes.

responses (Lang et al., 2001; Mikels et al., 2005). The images were selected based on similarity to disgust prime images; only images depicting inanimate scenes were used.

Sexual arousal images—In order to assess psychological sexual arousal and behavioral avoidance in the sexual domain, 12 sexually explicit images¹ from the IAPS were used. The 12 images displayed male-female dyads engaging in various sexual or affectionate acts. Women's bare breasts and men's bare chests were displayed in each image. For theoretical reasons and in order to enhance uniformity across images, images were cropped in order to remove depictions of genitals and pubic hair².

Given that norms for sexual arousal ratings of the sexual images utilized in this study are not available, ratings from sexual images used in the current study were compared to ratings of neutral images. A separate sample ($n = 203$) was collected and presented with a series of 12 images³ from the IAPS that depicted humans engaging in everyday activities (e.g., reading). These images had previously been rated as emotionally neutral (Lang et al., 2001; Mikels et al., 2005) and did not depict any potentially pathogen disgust inducing imagery (e.g., no images contain bodily fluids). Neutral image ratings were compared with sexual image ratings from the neutral prime condition. Two (one for each gender) independent samples t -tests with equal variances not assumed (variances were significantly different) were conducted with sexual image condition (sexual vs. neutral images) as the independent variable and sexual arousal ratings as the dependent variable. Results suggested that both men ($M_{\text{sexual}} = 59.16$, $SD_{\text{sexual}} = 24.79$, $M_{\text{neutral}} = 18.93$, $SD_{\text{neutral}} = 20.08$) and women ($M_{\text{sexual}} = 43.73$, $SD_{\text{sexual}} = 27.43$, $M_{\text{neutral}} = 14.30$, $SD_{\text{neutral}} = 15.13$) rated the sexual images as significantly more sexually arousing than neutral images, $t_{\text{men}}(70.54) = 7.65$, $p_{\text{men}} < .001$, $t_{\text{women}}(131.81) = 10.32$, $p_{\text{women}} < .001$.

Measures

Sexual arousal—In order to assess the primary dependent variables, participants were asked to rate their subjective sexual arousal to each sexual image via a self-report scale that ranged from 0 to 100, with higher scores indicating greater sexual arousal. The scale was presented to participants as a sliding button on a webpage. See Table 2 for descriptive statistics. The same procedure was used for neutral images used for image validation.

Behavioral avoidance—To determine the degree to which participants avoided sexual images, we recorded the amount of time they spent viewing sexual images. Similar to evidence suggesting that individuals look away from a stimulus as a method of avoidance in classical conditioning paradigms investigating disgust responding (Armstrong et al., 2014), the time a participant viewed an image before advancing to the next image and thereby removing the previous image was utilized as a measure of behavioral avoidance.

¹IAPS images numbered 4647, 4651, 4652, 4653, 4656, 4664, 4670, 4672, 4676, 4687, 4694, and 4800 were used as sexual images rated by participants.

²IAPS images 4647, 4664, and 4672 were cropped to remove depictions of genitals and pubic hair.

³IAPS images numbered 2038, 2102, 2104, 2190, 2393, 2397, 2480, 2570, 2580, 2620, 2850, and 2890 were used as neutral images rated by participants.

Disgust propensity—The TDDS (Tybur et al., 2009) was used to assess disgust propensity. This 21-item self-report measure produces three subscales: (1) pathogen, (2) moral, and (3) sexual disgust domains. The pathogen disgust scale assesses the degree to which stimuli that are highly associated with disease (e.g., feces) elicit disgust. Similarly, the moral scale assesses the degree to which violations of moral ideals (e.g., stealing) elicit disgust responses, and the sexual scale assesses the degree to which sexual stimuli (e.g., engaging in oral sex) elicit disgust responses. The sexual and pathogen subscales were used in analyses for the current study. In previous studies, the sexual and pathogen subscales have demonstrated good inter-item consistency (Cronbach $\alpha > .80$), concurrent validity, and discriminant validity (Tybur et al., 2009; Tybur et al., 2011). In the current sample, both subscales demonstrated good inter-item consistency (Cronbach $\alpha > .80$). See Table 2 for descriptive statistics. In order to examine if disgust and sexual primes impacted TDDS ratings, the sample that completed image validation for sexual arousal images also completed the TDDS. No significant differences were found between any group on any TDDS subscale (p -values $> .10$).

Analytical Approach

Hypothesized relations between disgust and sex—We first hypothesized disgust priming would (a) inhibit sexual arousal to and (b) increase avoidance of subsequent sexual stimuli. We hypothesized the inhibitory role of disgust on sexual arousal would be stronger in women than in men, as women tend to endorse significantly more sexual disgust propensity than men (Tybur et al., 2011; Tybur et al., 2009), the majority of theoretical work on the mutual inhibition of disgust and sexual arousal applies exclusively to women (de Jong et al., 2013), and some correlational evidence suggests that sexual arousal may only inhibit disgust responding among women (Lee et al., 2014).

The current study also examined the relations between sexual and pathogen disgust propensity, and sexual arousal and behavioral avoidance. We expected that pathogen disgust propensity would moderate the effect of pathogen disgust induction on sexual arousal and avoidance. We expected that sexual disgust propensity would negatively predict sexual arousal and positively predict sexual avoidance.

In order to examine hypothesized relations between disgust and sex, two two-level hierarchical linear models (HLMs) were completed—one for each dependent variable: viewing time and sexual arousal ratings. The initial model was the same for both dependent variables. Observations for each image were nested within individuals. Image order was the only level 1 (within individual) predictor. Image order was centered on the first image. Experimental condition, gender, age, pathogen disgust, and sexual disgust were examined as level 2 (between individuals) predictors. In order to examine the hypothesis that the effect of disgust would be greater for women than men, the interactions of gender and experimental condition were examined. The interactions of both disgust subscales with experimental condition were also included.

Examination of spillover effects—Given the proposed cyclical, mutually-inhibitory relation between disgust and sexual arousal, spillover effects were also explored. That is, we

examined the degree to which repeated exposure to pathogen disgust primes and sexual arousal stimuli impacted arousal to subsequent sexual stimuli.

In order to examine spillover effects, the random effect of image order was examined for both dependent variables. This examined the degree to which participants changed their sexual arousal scores or viewing time as the experiment proceeded. Tests of cross-level interactions were then conducted on level 2 (between individuals) factors and the random effect of image order. In accordance with recommendations by Preacher, Curran, and Bauer (2006), this was accomplished by examining the relations of level 2 predictors and a latent factor representing the random level 1 slope. Examining level 2 predictors of the random effect of image order allowed us to examine the degree to which specific variables (e.g., gender) predict changes in sexual arousal scores or viewing time as the experiment proceeded. The same between-level predictors of sexual arousal were used as predictors of the level 1 random slope.

To enhance interpretability, pathogen disgust, sexual disgust, and age were grand-mean centered. After examining initial models, non-significant interaction terms were removed iteratively from analyses in order to ensure model parsimony, such that final models included only main effects and significant interactions. All analyses were completed in Mplus version 6.

Results

Data Correction and Analytic Assumptions—Prior to beginning data analyses, we explored missing data patterns and variable distributions. Little's MCAR test suggested data were not missing completely at random ($p < .05$). Upon further exploration, it appeared that missingness of sexual arousal ratings was positively correlated with sexual disgust propensity ($p < .001$). Missing data were estimated with full information maximum likelihood estimation, which has been demonstrated as an optimal estimation technique when data are not missing completely at random (Enders, 2001; Peyre, Lepage, & Coste, 2010).

Analyses of normality suggested that the sexual subscale of the TDDS, the mean scores for length of time viewing images, and the sexual arousal scores were significantly kurtotic. Variables included in analyses were multivariate kurtotic. The sexual subscale of the TDDS, sexual arousal ratings, and viewing time were transformed. Following transformations, issues with univariate and multivariate normality were resolved. Analyses with transformed data did not differ in the significance or direction of effects compared to untransformed data. In order to maintain interpretability of findings, results are presented with untransformed data.

Disgust and Sexual Arousal—Results of the final HLM examining sexual arousal ratings are summarized in Table 3. The interactions involving pathogen disgust and sexual disgust were all non-significant (p -values $> .10$) and were removed from analyses. The interaction of experimental condition and gender did not significantly predict sexual arousal ratings ($p = .610$), and it was also removed from analyses. In the final model, experimental condition, gender, and age were retained as between-cluster predictors of sexual arousal.

Results of these main effects suggested that sexual arousal ratings were lower in the disgust condition than the neutral condition, higher for men than women, and positively associated with age (p -values $< .05$). Experimental condition, gender, age, pathogen disgust, sexual disgust, and the interaction of experimental condition and gender were retained as predictors of the random slope of image order predicting sexual arousal ratings. Sexual disgust was positively associated with the random slope and women appeared to have a more negative slope than men (p -values $< .05$). The interaction of gender and experimental condition was also a significant predictor of the level 1 random slope ($p = .006$).

In accordance with recommendations by Curran, Bauer, and Willoughby (2006), the gender-by-condition interaction effect on the random slope was probed by altering dummy-coding schemes and interpreting the random slope intercept as the simple slope of the group coded as “0” among all predictors. Results suggested that the simple slopes for women in both conditions ($w_{\text{disgust}} = -1.09$, $SE = 0.28$, $p < .001$; $w_{\text{neutral}} = -.76$, $SE = 0.21$, $p < .001$) and men in the neutral condition ($w = -1.60$, $SE = 0.37$, $p < .001$) were significant and negative, suggesting each group rated images as less arousing as the experiment progressed. The slope for men in the disgust condition was not significant ($w = -0.04$, $SE = 0.37$, $p = .280$). Figure 1 depicts estimated slopes and intercepts.

Disgust and Viewing Time—Results from the HLM predicting the length of time participants viewed images are presented in Table 4. No interaction variables were significant (p -values $> .10$) and all interaction terms were removed from the final model. The relation between TDDS sexual subscale and viewing time was significant in HLM analyses, but the zero-order correlation was not significant. As a result, this effect was not interpreted. No other predictor was significant (p -values $> .10$). The correlation matrix of variables included in analyses is presented in Table 5.

Discussion

The current study examined the relation between disgust and sexual avoidance and arousal. Specifically, the study experimentally examined the effect of pathogen disgust primes on sexual avoidance and arousal, and correlationally examined the relation between sexual disgust propensity, pathogen disgust propensity, and sexual avoidance and arousal. In general, results support a complex relation between disgust and sexual variables. Results are notable for several specific findings. First, experimentally induced pathogen disgust appears to initially inhibit sexual arousal to visual stimuli; however, induced disgust did not appear to alter avoidance among either men or women. Second, the relation between disgust and sexual arousal differs between men and women in a complex fashion. While the main effect of disgust did not significantly differ between men and women overall, disgust appeared to have a different effect for men than for women as participants were presented with additional image pairs. Specifically, relative to women in the neutral condition, women in the disgust condition rated images as less arousing overall and evidenced a steeper decline in sexual arousal ratings as additional image pairs were presented; however, women in both conditions rated images as less arousing as the experiment progressed. For men, participants in the neutral condition rated images as less arousing as they were presented with additional image pairs, but men in the disgust condition did not. For women, these data largely cohere

with previous theoretical work, which has suggested that sexual arousal would be diminished when individuals are unable to disengage from attending to pathogen disgust stimuli (e.g., bodily fluids) during sexual contact (de Jong et al., 2010; de Jong et al., 2013). Results for women also support the proposed dysfunctional cycle in which pathogen disgust stimuli inhibit arousal to sexual stimuli as the two are presented in tandem. In other words, pathogen disgust inhibits arousal to sexual stimuli initially, and this effect becomes larger as pathogen disgust and sexual stimuli are presented together. Unexpectedly, these data do not support hypotheses that pathogen disgust would increase avoidance in either gender. Moreover, while disgust appeared to inhibit sexual arousal overall for both men and women, men did not exhibit the same pattern of diminishing sexual arousal as women. Only men in the neutral condition evidenced a significant decline in sexual arousal ratings as additional image pairs were presented. Also, the current research does not support hypotheses that sexual disgust would correlate with arousal to sexual stimuli or sexual avoidance. The correlation between sexual disgust and sexual avoidance was significant in HLM analyses, but this effect was not interpretable as the zero-order correlation was not significant among men or women (see Table 5).

The current research extends previous research which had largely examined the inhibiting impact of sexual arousal on experiences of disgust (Ariely & Loewenstein, 2006; Borg & de Jong, 2012; Stevenson et al., 2011) or correlationally explored the relations between disgust propensity and sexual dysfunction (Borg et al., 2010; Borg et al., 2011; de Jong et al., 2009). This study is among the first to experimentally explore the effect of disgust on sexual arousal and to explore the relation between a domain of sexual functioning (e.g., sexual arousal) and disgust among both men and women. The support found for the inhibitory effect of pathogen disgust on sexual arousal, though preliminary, may provide clinically-relevant information regarding sexual dysfunction and novel insights into the hypothesized relation between disgust and sexual arousal.

Mutual Inhibition of Sex and Disgust

Experimental work has already begun to establish the inhibitory function of sexual arousal on disgust responding among both men and women (Ariely & Loewenstein, 2006; Borg & de Jong, 2012; Stevenson et al., 2011). As such, combining these data with previous experimental work supports the proposed mutually inhibitory relation between pathogen disgust and sexual arousal (de Jong et al., 2010; de Jong et al., 2013), although these processes appear different among men and women. For women, eliciting one response appears to prevent the other from occurring (or at least diminishes the subjective experience of the response) and the effect of disgust on sexual arousal appears to become larger as disgust stimuli are consistently paired with sexual stimuli; however, the effect of disgust does not become larger in the same fashion for men and may only initially inhibit sexual arousal. Mutual inhibition of disgust and sex may provide significant evolutionary benefit for humans, as disgust may dampen appetitive responding to sex at times when risk of infection during sexual contact may be higher (e.g., when pathogens or contracted illnesses are more prevalent) and sexual arousal may allow for the enduring of pathogen disgust stimuli (e.g., bodily fluids) in order for mating to occur. This mutual inhibition, then, may aid in engaging in sex during optimal periods and avoiding sex in less optimal situations.

Further, women may evidence a larger effect than men due to greater evolutionary pressures to avoid disease. As discussed previously, most of the evidence cited in support of theoretical proposals for mutual inhibition of disgust and sex applies only to women (e.g., enhanced disgust propensity during less fertile time periods; Fessler & Navarette, 2003).

Data regarding the behavioral measure of sexual avoidance temper findings related to the proposed mutual inhibition of disgust and sex. Disgust priming did not appear to have an impact on the sexual image viewing time. It is unclear why experimentally induced disgust produced differential results with self-reported sexual arousal and behavioral measures; however, this may imply that disgust responses reduce excitation during sexual activity, but may not lead to avoidance of sexual activity. Alternatively, this finding may be the result of the methodology of the study, as brief visual primes may not sufficiently prime disgust and consequently may not sufficiently inhibit sexual arousal to produce avoidance. Additionally, the utilized measures of avoidance—self-pacing while viewing sexual images—may not fully capture avoidance of sexual stimuli. That is, participants were not given the opportunity to elect exposure to sexual stimuli, as might be the case in natural contexts. They were only able to limit their exposure to the stimuli (advancing through procedures more quickly). A different behavioral approach task in which participants are able to discontinue with sexual stimuli without discontinuing from the entire study may afford different results.

Unlike results for women, the effect of experimentally induced disgust did not increase for men. In fact, the effect of disgust appeared to *decrease* as additional image pairs were presented. As one potential explanation, sexual arousal to early images may diminish the effect of disgust primes for men. This explanation, however, does not fully explain the pattern of data observed as men in the neutral condition provided progressively lower ratings of sexual arousal as additional pairs were presented, whereas men in the disgust condition maintained relatively equivalent ratings throughout. Said differently, sexual arousal stimuli diminished in their effect as the experiment progressed, and the disgust primes limited the decline in sexual arousal. Disgust may achieve this through multiple potential mechanisms in the current experiment. Similar to recent correlational findings (Grauvogl et al., 2014), disgust primes may have increased sexual arousal as the experiment progressed. While the initial effect of disgust on subjective sexual arousal may be inhibitory, disgust may subsequently increase sexual arousal as physiological responding to disgust cues increases. This may be similar to explanations of the excitatory effect of anxiety on sexual arousal (e.g., Barlow et al., 1983) in that sympathetic arousal may lead to subsequent increases in sexual arousal. Alternatively, disgust primes may have served an orienting or attention-enhancing function such that men in the disgust condition retained the same degree of attention and engagement throughout the experiment and those in neutral condition did not. The images presented in the current study may not have sufficiently elicited sexual arousal for men, as these images were significantly less explicit than other visual sexual stimuli that are widely available on the internet and consumed by the overwhelming majority of college-age men (Carroll et al., 2008; Morgan, 2011).

Multiple additional explanations for the gender discrepancy were explored in *post hoc* analyses not presented within the current manuscript, as none of the analyses yielded

significant results. Among some of the alternative explanations explored, the gender discrepancy does not appear to be the result of gender differences in disgust propensity; results remained unchanged with a similarly small effect size among men with degrees of disgust propensity comparable to women. It is possible, though, that this finding may be limited to visual sexual stimuli, as women appear to experience greater disgust responses to visual depictions of sex with disgust when compared to men (Mosher & MacLan, 1994). Further, the gender difference may also result from physiological and psychological sexual arousal concordance differences between men and women. Physiological sexual arousal was not assessed in the current study, as it is not the component of sexual arousal implicated in the mutual inhibition of disgust and sexual arousal. However, disgust may impact various components of sexual arousal differently. To explore this further, future work should include alternative methods for eliciting and measuring disgust and sexual arousal.

Strengths and Limitations

The current study is limited by several factors. First, this study utilized a relatively young college sample with a sizeable minority of participants who reported never having experienced any sexual activity. As a result, findings may not generalize to older samples or samples with more sexual experience. Further, the current study examined a behavior that minimizes contact with stimuli (i.e., spending less time viewing a picture) as the key measurement of avoidance. Other procedural methods, such as asking participants to select between sexual and non-sexual stimuli, could be used for assessing avoidance of sexual stimuli. Additionally, the current study utilized only a visual domain of stimuli for both priming and sexual arousal materials. Future work should examine the degree to which the current findings extend to other methods for inducing disgust (e.g., scent) and sexual arousal (e.g., imaginary or verbal). Although experimental groups did not significantly differ in sexual disgust propensity, sexual arousal stimuli has previously been shown to decrease sexual disgust propensity among women (Lee et al., 2014) and measuring sexual disgust after the experimental phase may have presented some bias in sexual disgust scores. The current analysis of data also excluded participants who identified as being attracted to only members of the same sex. As a result, generalizability is limited to heterosexual populations. Lastly, sexual arousal scores were not missing completely at random. In fact, missingness of sexual arousal scores was significantly related to sexual disgust propensity and may have somewhat biased the results. This bias is likely tempered by the use of full information maximum likelihood to estimate missing data. Moreover, greater degrees of missingness among those high in sexual disgust propensity relative to those with low sexual disgust propensity would likely diminish the principal effects found in the current study, as those with high sexual disgust propensity may be more sensitive to disgust primes. Individuals with high disgust propensity providing fewer ratings than those with low disgust propensity, however, may reduce the likelihood of finding an effect of sexual disgust propensity on sexual arousal. As a result, the current findings should be interpreted with caution.

Future Directions

Findings from this study provide evidence for the relation between disgust and sexual arousal, but many facets of this relation remain unexplored. Research should continue to explore the nature of this relation across domains of stimuli other than visual (e.g., scent-

based priming of disgust). Research should also examine mechanisms for the gender differences in the relation between disgust and sexual arousal. This may include utilizing physiological and psychological measures of sexual arousal. Investigations of the relation between sexual disgust and avoidance of sexual stimuli would benefit from measuring sexual avoidance in other ways, such as diary reporting of refusal of partner initiation of sexual activity. Further, research should explore methods for inducing sexual disgust in order to utilize validated sexual disgust stimuli in experimental procedures involving sexual avoidance and arousal. Given the possible role of attention to disgust stimuli in inhibiting sexual arousal, future studies should explicitly examine attention.

Conclusion

The current study suggests disgust plays an important role in sexual arousal and sexual avoidance. The role disgust plays appears complex, and different forms of disgust (pathogen disgust vs. sexual disgust) appear to impact sexual arousal and avoidance in different ways. Results also suggest that disgust priming may differentially impact men's and women's sexual arousal. Specifically, experimentally induced pathogen disgust appears to inhibit sexual arousal and the effect becomes larger over time for women, but not men. Additionally, sexual disgust propensity, the trait-like degree to which someone is disgusted by various sexual stimuli, does not relate to sexual arousal in either gender. Conversely, experimentally induced pathogen disgust does not appear to impact avoidance of visual sexual stimuli. Taken together, the current results offer at least partial support for the mutually inhibitory relation between disgust and sexual arousal and suggest disgust may be an important factor to consider in understanding sexual responding and dysfunction.

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Figure 1.

The Effect of Disgust Priming on Sexual Arousal Ratings for Men and Women

Note: *Estimation based on hierarchical linear model centered on Image 1 with sexual arousal ratings centered on the grand mean and sexual disgust propensity, pathogen disgust propensity, and age examined as covariates. All covariates were mean centered.

Table 1

Participant Demographic Data

87 Men	<i>N</i>	Percent
Ethnicity		
Latino/Hispanic	64	73.6%
Black/African American	7	8.0%
White/Caucasian	11	12.6%
Asian/Asian American	1	1.1%
Hawaiian/Pacific Islander	0	0.0%
Native American	0	0.0%
Multiethnic/Multiracial	4	4.6%
Sexual history		
Engaged in sexual intercourse	64	73.6%

206 Women	<i>N</i>	Percent
Ethnicity		
Latino/Hispanic	139	67.5%
Black/African American	32	15.5%
White/Caucasian	17	8.3%
Asian/Asian American	7	3.4%
Hawaiian/Pacific Islander	1	0.5%
Native American	1	0.5%
Multiethnic/multiracial	7	3.4%
Sexual history		
Engaged in sexual intercourse	170	82.5%

Table 2

Descriptive Data of Variables Included in Analyses

Men	<i>N</i>	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Mean arousal ratings of sexual images [*]	85	59.16	24.79	0.00	99.83
Disgust condition	43	61.88	25.96	2.75	99.83
Neutral condition	42	57.34	23.07	2.75	96.83
Mean seconds viewing sexual images	87	21.34	22.72	3.25	147.73
Disgust condition	44	19.50	18.60	3.25	99.42
Neutral condition	43	23.22	26.38	6.56	147.73
TDDS [‡] pathogen [*]	87	4.15	1.08	1.00	6.00
Disgust condition	44	4.10	1.15	1.00	6.00
Neutral condition	43	4.19	1.01	2.00	6.00
TDDS [‡] sexual [*]	87	2.75	1.09	1.00	6.00
Disgust condition	44	2.81	1.33	1.00	6.00
Neutral condition	43	2.69	1.36	1.00	5.57
Women	<i>N</i>	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
Mean arousal ratings of sexual images [*]	194	43.60	27.82	0.00	100.00
Disgust condition	98	38.47	26.19	0.00	100.00
Neutral condition	96	48.84	28.60	0.00	100.00
Mean seconds viewing sexual images	206	17.65	11.27	2.83	89.02
Disgust condition	105	17.75	12.24	2.83	89.02
Neutral condition	101	17.54	10.22	4.35	58.58
TDDS [‡] pathogen [*]	206	4.57	0.96	1.00	6.00
Disgust condition	105	4.58	1.03	1.00	6.00
Neutral condition	101	4.66	0.89	2.14	6.00
TDDS [‡] sexual [*]	206	3.97	1.10	1.00	6.00
Disgust condition	105	3.87	1.11	1.00	6.00
Neutral condition	101	4.08	1.10	1.71	6.00

Note:

[‡]Three Domain Disgust Scale^{*} variables were significantly different ($p < .05$) between men and women across all conditions.

Table 3

HLM Results of the Effect of Disgust on Sexual Arousal

Predictors of Arousal Ratings	Coeff. (SE)	<i>p</i>
Age	1.00 (0.25)	<.001
Gender	16.50 (4.33)	<.001
TDDS [†] sexual	−0.46 (0.27)	.079
TDDS [†] pathogen	0.03 (0.26)	.903
Disgust condition	−7.87 (3.49)	.024

Predictors of the Image Order Slope	Coeff. (SE)	<i>p</i>
Age	−0.05 (0.25)	<.001
Gender	−0.95 (0.42)	.025
TDDS [†] sexual	0.04 (0.02)	.048
TDDS [†] pathogen	−0.01 (0.02)	.790
Disgust condition	−0.27 (0.33)	.411
Gender × disgust condition	1.48 (0.54)	.006

Note:

[†]Three Domain Disgust Scale

Table 4

HLM Results for the Effect of Disgust on Image Viewing Time

Variable	Coeff. (SE)	<i>p</i>
Age	−0.21 (0.13)	.109
Gender	8.41 (5.53)	.128
TDDS [‡] sexual*	−0.17 (0.08)	.030
TDDS [‡] pathogen	0.03 (0.21)	.872
Disgust condition	−0.56 (3.47)	.960

Note:

[‡]Three Domain Disgust Scale;

* This effect was not interpreted as the zero-order correlation was not significant and suggests the significant effect may be the result of a suppression effect.

Table 5 Pearson r Correlation Matrix of Variables Used in Analyses

	Age	Sexual	Pathogen	Arousal	Time
Age	-	-.21**	.01	.19**	-.07
Sexual [†]	-.21	-	.39***	-.07	-.12
Pathogen [‡]	.05	.24*	-	.01	-.13
Arousal	.03	-.17	-.10	-	.04
Time	-.13	-.03	.01	.05	-

Note: Correlations for women are presented above the diagonal and correlations for men are presented below the diagonal.

[†] Three Domain Disgust Scale sexual subscale

[‡] Three Domain Disgust Scale pathogen subscale. Arousal and time represent averages of the 12 images presented to participants.

*
 $p < .05$

**
 $p < .01$

***
 $p < .001$