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Research article

Induced disgust affects implicit and explicit responses toward gay men and lesbians

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Abstract

In the current study, disgust was induced using a carefully controlled odor manipulation to observe its effect on participants' implicit and explicit responses to homosexuals. Participants were presented with a vial containing an odor that was described as "body odor" ($n = 47$) that induced a high level of disgust, or "parmesan cheese" ($n = 43$) that induced a moderate level of disgust, or an odor-free vial ($n = 53$). Subsequently, participants viewed images of homosexual and heterosexual couples, and their viewing times and ratings of the images' pleasantness were recorded. Additionally, they completed a "feelings thermometer" task and the Attitudes Toward Lesbians and Gay Men scale that assessed feelings toward homosexuals and the Three-Domain Disgust Scale to measure sensitivity along three dimensions of disgust (pathogen, moral, and sexual). Results indicated that those in the body odor condition viewed images of gay (but not lesbian) couples for less time relative to images of heterosexual couples compared with participants in the other two conditions. With respect to explicit ratings, participants in the body odor condition reported colder feelings for gay relative to heterosexual men on the feelings thermometer compared with those in the no-odor control condition. For pleasantness ratings, the odor manipulation served as a moderator, such that for those in the body odor condition only, higher sensitivity to sexual disgust predicted lower ratings for images of lesbian couples relative to the heterosexual couples. Thus, although induction of disgust biases implicit and explicit responses to gay couples, the degree to which this occurs for explicit ratings of lesbian couples depends on levels of sexual disgust. Copyright © 2013 John Wiley & Sons, Ltd.

Disgust is an emotional reaction frequently associated with unpleasant physical stimuli. The revulsion felt at certain sights, smells, sounds, and tastes is thought to serve a protective function, motivating avoidance and rejection of substances and situations in which there is threat of contamination or disease (Oaten, Stevenson, & Case, 2009; Rozin, Haidt, & McCauley, 2008). Disgust predicts the fear of contamination in many different settings (Mancini, Gragnani, & D'Olimpio, 2001; Thorpe, Patel, & Simonds, 2003; Tolin, Woods, & Abramowitz, 2006) that extend beyond the physical and into moral and social domains (Rozin et al., 2008), where it can shape moral and social judgments.

To demonstrate this in the moral domain, Wheatley and Haidt (2005) used posthypnotic suggestion to induce disgust for a neutral target word. When descriptions of moral transgressions contained either the target or a control word, participants rated those with the target word as both more disgusting and morally wrong relative to those that contained the matched control word. Similar results were found when disgust was elicited by a bitter-tasting beverage (Eskine, Kacirik, & Prinz, 2011). It is important to note, however, that disgust does not affect all moral judgments to the same degree. Rather, disgust has been shown primarily to influence judgments associated with violations of individual purity or sanctity (Rozin, Lowery, Imada, & Haidt, 1999; Horberg, Oveis, Keltner, & Cohen, 2009).

In the social domain, disgust primarily influences perceptions of social groups that have historically been marginalized. In particular, disgust toward a social outgroup can occur when the group is believed to be dangerous or have values different from the ingroup, contributing to the desire to avoid the potentially threatening outgroup (Cottrell & Neuberg, 2005; Faulkner, Schaller, Park, & Duncan, 2004; Park, Schaller, & Crandall, 2007). In fact, some forms of prejudice appear to result in part from the need to limit contact with people who may pose a high risk for disease transmission because of cultural differences in hygiene and food preparation (Faulkner et al., 2004; Navarrete & Fessler, 2006). In support of this idea, research by Faulkner et al. (2004) suggests that a greater concern with chronic disease is associated with more negative attitudes toward unfamiliar immigrant groups. Furthermore, a disease-salient prime was shown to lead individuals to have more negative attitudes toward outgroup immigrants (Faulkner et al., 2004). Disgust experiences are therefore expected to negatively influence judgments of groups that are considered impure or in violation of the natural order (Dasgupta, Desteno, Williams, & Hunsinger, 2009).

Throughout history, homosexuals have been a morally condemned outgroup and have become a social category with particularly strong disgust associations. Recent work has examined whether attitudes toward homosexuals vary as a function of disgust. In a study where participants placed

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images of homosexual and heterosexual couples, pictograms, and pictures of wedding cake toppers into categories related to valence and sexual orientation, Inbar, Pizarro, Knobe, and Bloom (2009) found that participants who were more disgust sensitive implicitly evaluated homosexual cues less favorably compared with heterosexual cues. These findings were further extended by Dasgupta et al. (2009) who found that participants who felt disgusted had more negative implicit attitudes toward homosexuality compared with those who felt angry or were in a neutral mood. More recently, Inbar, Pizarro, and Bloom (2012) found that participants exposed to a disgusting ambient odor expressed more negative explicit evaluations of gay men.

Overall, the research in this emerging area of investigation has been somewhat limited by the narrow range of methodologies employed. First, research investigating the impact of disgust on implicit attitudes toward homosexuality has typically utilized some form of the Gay–Straight Implicit Association Test (IAT; Nosek, Banaji, & Greenwald, 2006). This task employs a range of targets that are meant to represent heterosexual and homosexual categories (e.g., group labels, symbolic representations of homosexuality, and photographs of couples), which may vary in their ability to induce implicit reactions. For example, implicit reactions to abstract homosexual symbols may be weaker compared with those induced by actual images of homosexual and heterosexual couples embracing or kissing. In addition, responses on the IAT can be influenced by various factors in addition to the attitudes that participants hold toward the two different groups, including participants' general processing speed and cultural norms. Furthermore, these studies typically examine responses to homosexual targets in general and do not assess whether responses to gay targets differ from those to lesbian targets. Therefore, one of the goals of the current study was to examine responses to gay and lesbian targets independently.

Second, the nature and intensity of disgust inductions across prior studies has been inconsistent, which renders comparison between these studies difficult. Disgust inductions tend to take the form of transient manipulations via film clips, photographs, self-reported real/imagined disgust experiences, or ambient odors (e.g., "stink spray" applied to a trashcan in the vicinity of the participant). With respect to the odor manipulation, it is unclear whether the participants' response to the stink spray was actually a result of disgust specifically or merely a response to odor stimulation more generally. Because of the close connection between the olfactory and limbic systems, odors, regardless of their hedonic tone (i.e., whether they have positive or negative valence), can easily modify affect, emotions, and mood. Moreover, cognitive performance can be affected by the presence of odors (Millot, Brand, & Morand, 2002). Thus, it is not sufficient to compare the behavior between an unpleasant ambient odor condition and a no-odor condition if one hopes to understand the role that disgust plays in affecting participants' differential responses to homosexuality. Thus, this type of odor manipulation does not preclude alternative explanations, such as the possibility that the odors made individuals feel more emotional or decreased their response times because of enhanced cognitive performance.

Given these limitations, the goal of the present study was to extend previous research by investigating whether the induction of disgust by a carefully controlled odor manipulation would affect other implicit measures in response to images of gay and lesbian couples. Specifically, we drew on previous research by olfaction researchers, which demonstrated that verbal labels can affect the perception of and hedonic responses to odors (de Araujo, Rolls, Velazco, Margot, & Cayeux, 2006; Herz, 2003; Herz & von Clef, 2001). For example, when the odor of a mixture of isovaleric and butyric acids was labeled as either parmesan cheese or body odor (or vomit), participants exhibited opposing perceptual, behavioral, and neural responses to the same odor that reflected the descriptive labels provided (de Araujo, 2006; Herz & von Clef, 2001). In the current study, we took advantage of this phenomenon to induce disgust in one group of participants while providing a true odor control to another group. To do this, we presented both groups with a vial containing a mixture of isovaleric and butyric acids; however, for one group, the odor in the vial was labeled as body odor, whereas for the other group, the odor was labeled as parmesan cheese to control for sensory exposure. A third group of participants was exposed to a vial containing no odor.

In the implicit task that followed the induction of disgust, participants viewed images of straight, gay, and lesbian couples and were asked to press the spacebar on a computer keyboard when finished in order to rate the images for pleasantness (Meier, Robinson, Gaither, & Heinert, 2006). This task does not measure implicit attitudes toward social groups, but rather is an implicit measure of the degree of discomfort with gay, lesbian, and straight couples. It is considered to be implicit because viewing times to the stimuli are independent of explicit judgments of the pictures, and participants are unaware that their viewing times are being recorded and are not categorizing the images into social categories. This task was selected in the current study because previous work has suggested that when the group is believed to be dangerous or have values different from the ingroup, individuals often attempt to avoid the potentially threatening outgroup (Cottrell & Neuberg, 2005; Faulkner et al., 2004; Park et al., 2007). Thus, quicker viewing times to particular stimuli demonstrate a higher level of avoidance or dismissal than slower viewing times (Meier et al., 2006). The ratings of the pictures in terms of their pleasantness were used as explicit evaluations of the pictures of gay, lesbian, and straight couples. In addition, explicit evaluations of warmth for each of the social groups (i.e., gay, lesbian, and straight) were measured with a series of feelings thermometers.

We hypothesized that even brief exposure to an odor construed as disgusting would cause more negative implicit and explicit appraisals of gay and lesbian couples relative to straight couples when compared with exposure to the same odor with a less hedonically negative label or no odor at all. Additionally, as part of this research, the influence of disgust sensitivity (Inbar et al., 2009) was examined, with the goal of obtaining a more comprehensive understanding on how individual differences in disgust sensitivity and induction of disgust interact to impact socio-moral judgments.

METHOD

Participants

Participants were 146 heterosexual undergraduates (51 male) enrolled in introductory psychology courses at the College of William & Mary in Williamsburg, VA. On average, participants were 18.8 years of age ($SD=1.4$). All participants received partial course credit for their participation. Procedures were approved by the William & Mary Protection of Human Subjects Committee, and written informed consent was obtained from each participant.

Materials

Odor Stimulus

The odor cue was prepared in each of four 25-mL Wheaton vials with screw-top caps under a fume hood. On the basis of Herz and von Clef (2001), each vial contained a 1:1 ratio (0.5 μ L each) of isovaleric acid (Sigma-Aldrich) and butyric acid (Sigma-Aldrich). Odors were refreshed on a weekly basis. Additional four vials were kept separate from the others and were not exposed to odors.

Picture Stimuli

Forty-two black and white images of gay, lesbian, and heterosexual couples were presented to participants. These photographs were collected from the internet and carefully matched across the three categories in terms of facial expressions, physical appearance, environment, posture/pose, and degree of emotional involvement. Together, these pictures formed 14 sets of corresponding gay, lesbian, and heterosexual images. All images were cropped to show only faces and upper torso.

Picture Viewing and Rating Task

Participants completed a picture viewing and rating task designed to assess implicit levels of discomfort toward homosexuality (Meier et al., 2006) as well as an explicit measure of the pleasantness of the images. In this task, the images of gay, lesbian, and heterosexual couples were randomly selected and presented one at a time in the center of a 17-in. LCD computer monitor using E-PRIME software (Psychology Software Tools, Inc., Pittsburgh, PA, USA). Participants were informed that the purpose of this task would be to rate the photos for use in future experiments. They were instructed to take as long as they needed to view each image to ensure an accurate rating, and to press the spacebar when they were ready to rate each image. Upon pressing the spacebar, participants were presented with a rating scale from 1 (*very unpleasant*) to 9 (*very pleasant*) and asked to rate the pleasantness of the photo. After a rating was selected, a blank screen appeared for an inter-trial interval of 500 milliseconds before the next image was presented. The time between presentation of the image and pressing the spacebar served as a measure of viewing time

(an implicit measure of discomfort toward the images, as defined by Meier et al., 2006).

Questionnaires

In addition to completing a demographic questionnaire in which they indicated their gender and age, participants also completed several validated questionnaires to assess explicit attitudes toward homosexuality and sensitivity to disgust.

Feelings Thermometer Task (Esses, Haddock, & Zanna, 1993)

In the feelings thermometer task, participants were asked to indicate their feelings toward 11 different social groups. For each group, participants were presented with a sliding scale from 0 (*cold*) to 100 (*warm*), with a neutral midpoint at 50, and were asked to indicate how they felt toward the group by sliding the scale to the appropriate number. Although primarily interested in feelings toward gay men, heterosexual men, lesbian women, and heterosexual women, we included seven other groups (i.e., African-Americans, college students, the elderly, and European Americans) to obscure the purpose of the measure and evaluate the specificity of the manipulation (Inbar et al., 2012).

Attitudes Toward Lesbians and Gay Men Scale (Herek, 1988)

The short form of the Attitudes Toward Lesbians and Gay Men (ATLG) was used to assess attitudes toward homosexuality. This scale consists of 10 items, with half assessing attitudes toward gay men (ATG) and half assessing attitudes toward lesbian women (ATL). Participants reported the degree to which they agreed with statements such as "Homosexual behavior between two men is just wrong" and "Lesbians just can't fit into our society" by using a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). This scale has been shown to have adequate internal consistency ($\alpha=.97$), and in the present study, internal consistency was similar to that previously reported ($\alpha=.94$). Responses were reverse coded where necessary and summed to create overall scores as well as ATL and ATG sub-scores, with higher scores indicating more negative attitudes toward homosexuality.

Three-Domain Disgust Scale (Tybur, Lieberman, & Griskevicius, 2009)

The Three-Domain Disgust Scale (TDDS) consists of 21 items designed to measure sensitivity along three dimensions of disgust (pathogen, moral, and sexual). Participants report how disgusting they find items such as "accidentally touching a person's bloody cut" (pathogen), "intentionally lying during a business transaction" (moral), or "a stranger of the opposite sex intentionally rubbing your thigh in an elevator" (sexual), using a 7-point scale from 0 (*not at all disgusting*) to 6 (*extremely disgusting*). Mean scores on the three TDDS subscales (~~pathogen, sexual, and moral~~) were calculated for each participant with higher scores representing greater sensitivity to disgust. Acceptable levels of internal consistency have been demonstrated for each subscale ($\alpha=.84-.87$). In the

current study, internal consistency of each subscale was similar to that previously reported ($\alpha = .84-.88$).

Procedure

Participants completed the experiment in small groups of two to four students. Upon arriving at the laboratory, each participant was seated at a private computer station approximately 70 cm from the computer screen, where they completed an informed consent form. The experimenter was a woman who took care not to wear any perfume or other product containing an odor. Each group was randomly assigned to either a neutral condition or one of two odor conditions. After the initial set of directions, all further instructions and tasks were computerized.

Each participant was first presented with a vial which either contained the odor or was odorless. Participants were instructed to open the container, sniff the contents once, close the container, and return it to the table in front of them. After participants sniffed the vial, those who had received an odorless vial were informed that they had experienced "clean air," whereas those who had received a bottle with the odor were informed that they had experienced either parmesan cheese odor or body odor, depending on their group assignment. To evaluate the effectiveness of the odor manipulation, we then asked a subset of 63 participants to rate the odor on the dimensions of perceived disgust, intensity, and unpleasantness using a scale from 1 (*not at all*) to 7 (*very*).

Participants then proceeded to the viewing time task. Upon completion of this task, they were directed to respond to the questionnaires, which were presented online. When finished with the questionnaires, participants were debriefed, thanked, and dismissed.

Data Analysis

For the picture viewing task, average viewing times were computed for each of the three categories: gay couples, lesbian couples, and straight couples. For each participant, trials with viewing times greater than 3 SDs from the mean for each image category (Ratcliff, 1993) and less than 100 milliseconds (Luce, 1986) were removed. This resulted in less than 3% of trials being excluded from analysis.

In order to assess participants' relative reactions to homosexual versus heterosexual couples, we calculated difference scores. These composite scores were calculated by subtracting participants' viewing times for images of gay couples from their viewing times for images of heterosexual couples (likewise, viewing times for images of lesbian couples were

subtracted from viewing times for images of heterosexual couples). Difference scores were calculated in a similar manner for the photo rating and feelings thermometer data. For all variables, higher difference scores indicated a preference for images of heterosexual over homosexual couples.

The analyses discussed in the succeeding paragraph are reported collapsing across participants' gender, as initial analyses indicated that responses did not differ as a function of this variable. Mean difference scores were submitted to one-way analyses of variance with odor condition (body odor, parmesan cheese, and no-odor control) as the independent variable. Post-hoc tests (Tukey honestly significant difference) were subsequently conducted for all analyses that reached significance. Additionally, correlational analyses were conducted to determine whether the difference scores for the dependent variables were related to participants' disgust sensitivity (TDDS) or attitudes toward homosexuals (ATLG).

RESULTS

Participant Characteristics

Of the 146 participants who completed the study, three were excluded from all analyses because of circumstances which interfered with their ability to effectively experience the odor (i.e., severe head cold, $n = 1$; use of perfume/cologne, $n = 2$). Of the remaining 143 participants, there were 47 (29 female) in the body odor condition, 43 (29 female) in the parmesan cheese condition, and 53 (35 female) in the no-odor control condition. As depicted in Table 1, these groups did not differ in male to female ratio, or age. Likewise, the groups did not differ with respect to their mean disgust sensitivity scores as measured by the TDDS subscales.

Manipulation Check

As shown in Table 2, participants rated the body odor as strongly disgusting, the parmesan cheese odor as moderately disgusting, and the no-odor control as mildly disgusting. As a result, there was a main effect of odor label condition for perceived disgust, $F(2, 60) = 44.56, p < .001, \eta^2 = 0.60$. Moreover, there was a main effect of intensity, $F(2, 60) = 31.56, p < .001, \eta^2 = 0.51$, and unpleasantness, $F(2, 60) = 15.78, p < .001, \eta^2 = 0.34$. Mean ratings of disgust, intensity, and unpleasantness were significantly lower in the no-odor control condition relative to the

Table 1. Participant characteristics

	Body odor ($n = 47$)	Parmesan cheese ($n = 43$)	No-odor control ($n = 53$)
Age (in years)	18.98 \pm 0.27	18.44 \pm 0.12	18.92 \pm 0.17
Gender (% female)	61.70	67.44	66.04
TDDS			
Pathogen (0–6)	4.37 \pm 0.14	4.18 \pm 0.17	3.97 \pm 0.16
Sexual (0–6)	3.76 \pm 0.19	3.77 \pm 0.24	3.74 \pm 0.22
Moral (0–6)	4.74 \pm 0.13	4.54 \pm 0.18	4.42 \pm 0.17
ATLG (10–70)	29.28 \pm 2.19	24.83 \pm 2.18	24.42 \pm 1.89

TDDS, Three-Domain Disgust Scale; ATLG, Attitudes Toward Lesbians and Gay Men.

Table 2. Mean odor ratings

	Body odor	Parmesan cheese	No-odor control
Disgust	6.14 ± 0.17*	4.70 ± 0.30*	2.45 ± 0.34*
Intensity	5.86 ± 0.17	5.20 ± 0.29	3.00 ± 0.32*
Unpleasantness	6.14 ± 0.24*	5.15 ± 0.30*	4.27 ± 0.16*

*Significantly different from the other two conditions, $p < .05$.

parmesan cheese and body odor conditions; all p values $< .01$. Moreover, participants in the body odor condition rated the odor as significantly more disgusting and unpleasant than those in the parmesan cheese condition; all p values $< .01$.

Correlational Analyses

Correlational analyses were conducted to determine whether the dependent variables were related to the ATLG and the T3 TDDS. As shown in Table 3, although there was a significant correlation between the straight–gay difference score for picture viewing time and the ATG difference scores for the picture viewing time task did not significantly correlate with any of the dimensions on the TDDS, suggesting that sensitivity to disgust was not related to implicit responses to the homosexual couples. As expected, strong positive correlations were found between straight–gay and the straight–lesbian difference scores on the feelings thermometer task and the ATG, the ATG, and the ATLG. Additionally, a relationship was observed between the straight–lesbian difference scores in the feelings thermometer task and the TDDS-sexual subscale score. Finally, for the image rating task, straight–gay difference scores correlated marginally with the ATG, and there was a significant correlation between straight–lesbian difference scores on the image rating task and TDDS-sexual scores.

Implicit Measure

In the viewing time task, four participants were excluded because they failed to follow instructions. As demonstrated in Figure 1, straight–gay viewing time difference scores differed as a function of odor label, $F(2, 130) = 4.99, p < .01, \eta^2 = 0.07$, with participants in the body odor condition exhibiting a significantly greater bias ($M = 352.02, SE = 86.47$) than participants in either the parmesan cheese ($M = 0.45, SE = 101.06; p < .01$) or no-odor control ($M = 1.00, SE = 82.12; p < .01$) conditions. However, no significant effect of condition on straight–lesbian difference scores was observed, $F(2, 130) = 1.18, p = .31$.

Explicit Measures

Feelings Thermometer

Fourteen participants who responded “100” to all 11 feelings thermometer items were excluded from this analysis, leaving 129 participants.¹ As shown in Figure 2, straight–gay feelings thermometer bias scores differed significantly as a function of odor label, $F(2, 124) = 3.55, p = .03, \eta^2 = 0.54$, with

¹When the same analyses were conducted with these participants included, the effects are the same, although the difference between the two conditions becomes marginally significant ($p = .06$).

straight–gay difference scores significantly more biased in the body odor condition ($M = 23.33, SE = 4.18$) than the no-odor control condition ($M = 9.57, SE = 3.06; p < .05$). The parmesan cheese condition ($M = 18.63, SE = 4.41$) did not differ from either of the other two conditions. There was no effect of odor label on straight–lesbian bias scores, $F(2, 125) = 1.84, p = .16$. To ensure that the impact of unpleasant odors was specific to attitudes regarding homosexuality, we also explored the effect of odor on attitudes toward African-Americans and the elderly (Inbar et al., 2012), finding that the odor condition did not affect race or age bias scores; p values $> .35$.

Image Ratings

There was no effect of odor condition for either the straight–lesbian or straight–gay rating scores, p values $> .15$. To examine whether participants’ disgust sensitivity and attitudes toward gays and lesbians interacted with the odor manipulation to predict participants’ ratings of the couples, we performed regression analyses. In separate analyses, scores on either the ATLG or the TDDS were mean-centered, odor condition was a categorical independent variable, and difference scores for the participants’ rating responses served as dependent variables.

Relationship between Attitudes Toward Gays and Lesbians and Image Ratings. When the ATLG was included as a continuous variable in the regression analyses, the overall model was significant, $R^2 = .19, F(5, 126) = 7.13, p < .001$, for the straight–gay difference scores in the image rating task. There was a significant interaction between odor condition and ATLG score, $\beta = -.05, t(126) = -2.12, p = .036$. Although ATLG scores did not predict straight–gay bias scores in the no-odor control condition, *simple slope* = $-0.0006, t(126) = -0.04, ns$, scores on the ATLG scale were negatively correlated with bias scores in the parmesan cheese condition, *simple slope* = $-0.05, t(126) = -2.94, p = .004$, and positively correlated with bias scores in the body odor label condition, *simple slope* = $0.07, t(126) = 4.91, p < .001$. Analyses conducted using scores on the ATG subscale provided the same result.

A similar pattern of results was found for the straight–lesbian image rating bias score. The overall model was significant ($R^2 = .13, F(5, 126) = 5.08, p < .001$), and a significant interaction was observed between odor condition and ATLG score, $\beta = -.04, t(126) = -2.14, p = .034$. For participants in the no-odor control condition, ATLG scores did not predict straight–lesbian bias scores, *simple slope* = $0.001, t(126) = 0.14, ns$. For participants in the parmesan cheese condition, scores on the ATLG scale were significantly negatively correlated with bias, *simple slope* = $-0.04, t(126) = -2.79, p = .006$; whereas for those in the body odor label condition, scores on the ATLG scale were significantly positively correlated with bias scores, *simple slope* = $0.05, t(126) = 3.81, p < .001$. The same pattern of results was observed for scores on the ATG subscale.

Relationship between Disgust Sensitivity and Image Ratings. When the sexual disgust subscale was entered into a separate regression analyses as a continuous variable, the overall model was significant, $R^2 = .07, F(5, 127) = 2.89, p = .017$, for the straight–lesbian difference scores. A significant interaction was observed between odor condition and TDDS-sexual

Table 3. Correlations between implicit and explicit measures of responses to gay and lesbian couples, and attitudes toward gays and lesbians and disgust sensitivity.

	Attitudes Toward Gays and Lesbians			Three-Domain Disgust Scale		
	ATG	ATL	ATLG	Pathogen	Moral	Sexual
Implicit measure						
Picture viewing task						
Straight–gay difference score	0.18*	0.10	0.15 [†]	–0.02	0.06	0.02
Straight–lesbian difference score	0.06	–0.01	0.03	–0.09	0.02	–0.01
Explicit measures						
Feeling thermometer						
Straight–gay	0.64**	0.60**	0.65**	0.08	–0.03	0.05
Straight–lesbian	0.42**	0.55**	0.50**	0.17	–0.06	0.18*
Picture rating task						
Straight–gay	0.14 [†]	0.10	0.13	0.13	0.01	0.01
Straight–lesbian	0.09	0.11	0.10	0.07	0.10	0.16*

ATG, attitudes toward gay men; ATL, attitudes toward lesbian women; ATLG, Attitudes Toward Lesbians and Gay Men.

**Significant correlation at $p < .01$;

*Significant correlation at $p < .05$;

[†]Marginally significant correlation at $p < .10$.

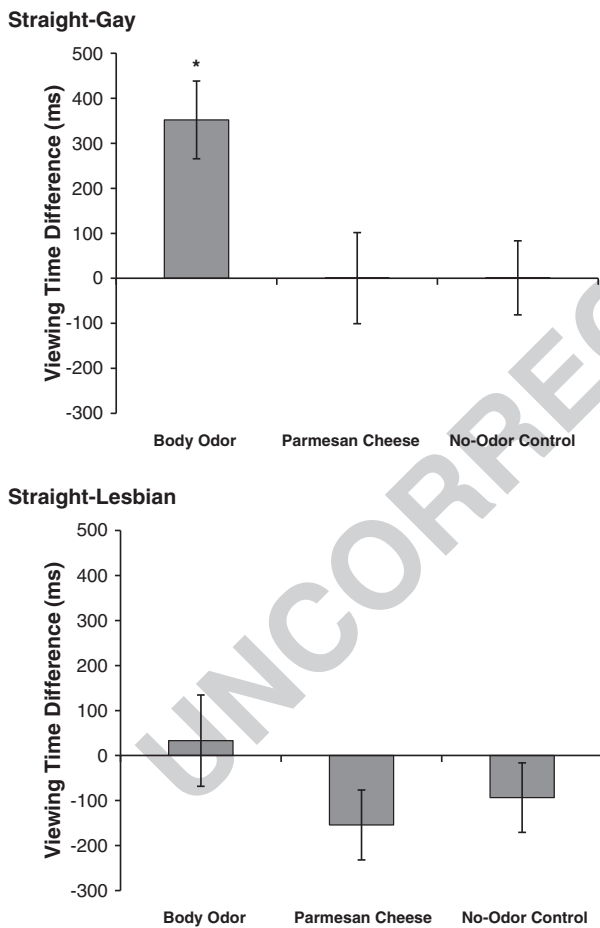


Figure 1. Straight–gay and straight–lesbian difference scores for image viewing times as a function of odor label condition. Higher scores reflect longer viewing times for heterosexual relative to gay men (i.e., more bias toward gay men). * indicates a significantly larger difference in viewing time relative to the parmesan cheese and the no-odor control conditions; $p < .05$

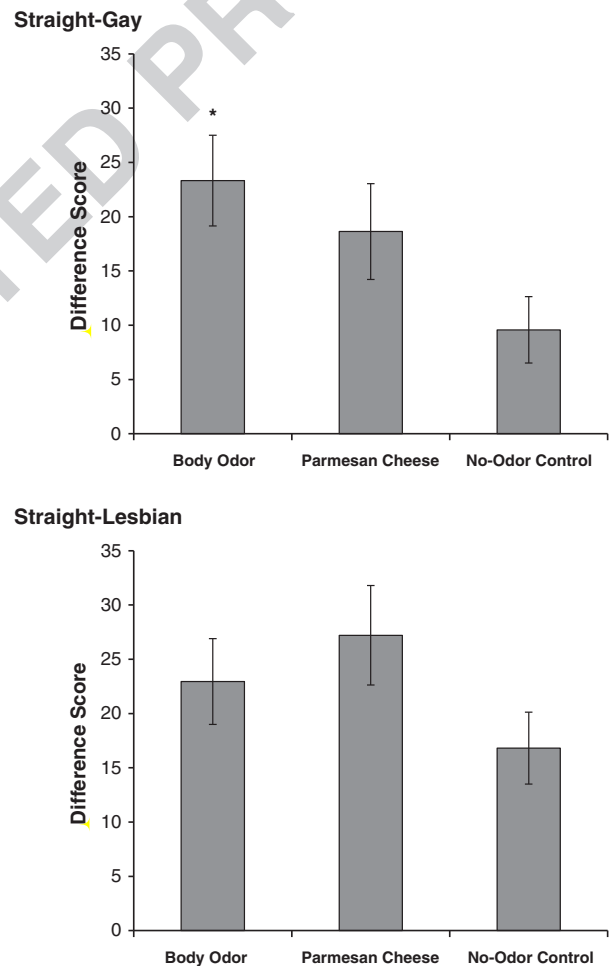


Figure 2. Straight–gay and straight–lesbian difference scores for the feelings thermometer as a function of odor label condition. Higher numbers reflect colder feelings toward gay relative to heterosexual men. * indicates a significantly higher mean relative to the no-odor control condition; $p < .05$

subscale score, $\beta = .49$, $t(127) = 2.40$, $p = .018$. As depicted in Figure 3, in the body odor condition, a positive relationship was observed between TDDS-sexual scores and straight–lesbian difference scores, *simple slope* = 0.54, $t(127) = 3.28$,

$p = .001$. However, TDDS-sexual scores did not predict straight–lesbian difference scores on the image rating task for participants in the no-odor control, *simple slope* = 0.05, $t(127) = 0.40$, *ns*, and parmesan cheese, *simple slope* = 0.03,

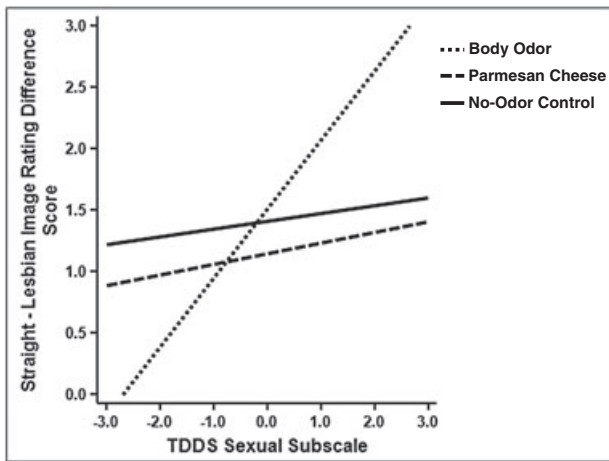


Figure 3. The relationship between straight-lesbian difference scores for pleasantness scores on the rating task and scores on the TDDS sexual dimension as a function of odor label condition

$t(127) = 0.23$, *ns*, conditions. The overall models were not significant for the straight-lesbian difference score when pathogen or moral subscales were entered, nor when any of the three subscales were entered for the straight-gay difference score.

DISCUSSION

The goal of the current study was to investigate how induction of disgust through a well-controlled odor manipulation affects implicit and explicit responses to gay men and lesbian women. Participants were briefly exposed to an odor that was labeled as parmesan cheese or body odor, or they were exposed to a vial with no odor. Following this manipulation, they completed implicit and explicit tasks that assessed responses toward straight, gay, and lesbian couples and groups. Consistent with previous research (de Araujo et al., 2006; Herz & von Clef, 2001), our manipulation check indicated that participants perceived the odor as more disgusting if it was labeled as body odor than parmesan cheese, and the two groups did not differ in their intensity ratings to the odor.

To investigate implicit responses to homosexuality, we measured participants' viewing time of the gay and lesbian couples relative to straight couples with a task that required them to press a spacebar when they were finished viewing the image (Meier et al., 2006). Results indicated that exposure to an odor that was construed as disgusting resulted in faster dismissal of gay couples in comparison to straight couples, whereas responses to lesbian couples were not affected by induction of disgust. Because participants in the current study were not placing the targets into evaluative or social categories, nor were they aware that the time to press the spacebar to dismiss the pictures was being recorded, we were able to acquire a truly implicit measure of aversion to (or avoidance of) the pictures of the gay and lesbian couples. A further advantage of this task was that it allowed us to examine responses toward gay and lesbian couples separately rather than responses to homosexuality overall, as has been previously done (Dasgupta et al., 2009; Inbar et al., 2009). The results of the

current study suggest that it is important to do so, as implicit responses to the photographs of the gay and lesbian couples were differentially affected by the disgust manipulation. As this is the first study to examine the effect of disgust on implicit responses to gay and lesbian couples separately, future research should seek to replicate these findings.

Consistent with results from the implicit task, results from the feeling thermometer task indicated that those in the body odor condition felt "colder" toward gay relative to straight men. This finding supports previous work by Inbar et al. (2012) demonstrating that explicit ATG, but not those toward lesbian women or other groups, such as the elderly or African-Americans, are negatively affected by a disgust manipulation. It is possible that induction of disgust affected implicit and explicit responses toward gay men but not lesbian women because gay men may be perceived as more "contaminated" or "impure," given the association with AIDS that is not necessarily present for lesbian women. As previous work suggests, disgust is more likely to negatively influence judgments of groups that are viewed as impure or in violation of the natural order (Dasgupta et al., 2009; Faulkner et al., 2004).

Although induction of disgust in the present study failed to affect participants' implicit responses and their reported feelings toward lesbian women, there appeared to be a complex relationship between disgust sensitivity and participants' ratings of lesbian couples. Although participants' ratings of the lesbian couple images did not differ between odor conditions, the odor manipulation moderated the relationship between explicit ratings of lesbian women and participants' sexual disgust sensitivity. That is, induction of disgust led participants with higher sexual disgust sensitivity scores to rate images of lesbian couples more negatively relative to straight couples. In combination with other work, these findings suggest that individual differences in both disgust sensitivity (in the current study) and conservatism (in Terrizzi, Shook, & Ventis, 2010) affect responses to homosexual pictures when disgust is induced.

In addition, the current study demonstrated that induction of disgust led participants with negative attitudes toward gays and lesbians to rate homosexual couples negatively. However, it is unclear as to why participants with negative attitudes toward gays and lesbians rated homosexual couples more *positively* when they experienced a moderately disgusting odor. Future research should continue to explore how disgust moderates potential relationships between biased responding to homosexuals and their attitudes toward gays and lesbians, as well as other characteristics and biased responding to gays and lesbians.

This is the first published study in this area that has carefully controlled the presentation of an odor in addition to its hedonic tone when inducing disgust. Participants in the parmesan cheese and body odor conditions received the same olfactory stimulation, and the disgust response was instead differentially induced by the label provided to describe the odor. This label manipulation provides evidence to support the contention that feelings of disgust, rather than a general increase in emotionality or cognitive performance that resulted from olfactory stimulation, induced differential responding to the homosexual groups and images. Moreover, our results suggest that separate examination of implicit and

explicit responses to gay men and lesbian women is important, as is examining the relationship between these responses and individual differences, such as sexual sensitivity.

Despite the strengths of this study, a number of limitations require acknowledgement. For example, some of our participants may not have liked the odor of parmesan cheese. Whether the participants who reported disliking parmesan cheese were disgusted by the odor is unknown; however, if this was the case, their responses would have only weakened our effects. In addition, as in many other studies in this area, our sample consisted of college students at a small liberal arts college, which decreases the external validity of our findings. Whether the effects reported in the present study would also occur in older and younger participants with different demographics is an important area for future investigation. Although gender of the participants in the present study did not appear to differentially affect implicit and explicit responses, more research that contains larger samples of men and women will provide more powerful evidence as to whether gender plays a moderating role in responses to homosexuality.

Conclusion

The present findings add to the growing body of literature that supports the contention that disgust plays a critical role in moral and social judgments (Dasgupta et al., 2009; Eskine et al., 2011; Inbar et al., 2009; Inbar et al., 2012) and is consistent with the contention that disgust, which originated from moral distaste, has become culturally enriched and recruited by other self-protection systems (e.g., Rozin, Haidt, & McCauley, 2000; Rozin, Markwith, & McCauley, 1994). In combination, these findings suggest that feelings of disgust predispose individuals to experience feelings that may impede positive intergroup responses toward homosexual individuals, a possibility that should be investigated empirically. Because disgust is modifiable through training and desensitization intervention (McKay, 2006), this emotion warrants further consideration in studies of prejudice in order to develop effective evidence-based strategies for reducing its negative effects on interpersonal interactions.

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