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Original Article

Self-Reported Sense of Smell Predicts Disgust Sensitivity and Disgust Reactivity

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Abstract: Two studies tested the hypothesis that self-reported sense of smell (i.e., metacognitive insight into one's olfactory ability) predicts disgust sensitivity and disgust reactivity. Consistent with our predictions two studies demonstrated that disgust correlates with self-reported sense of smell. Studies 1 and 2 demonstrated, from an individual difference perspective, that trait-like differences in disgust relate to self-reported sense of smell. Physical forms of disgust (i.e., sexual and pathogen disgust) drove this association. However, the association between self-reported sense of smell and disgust sensitivity is small, suggesting that it is likely not a good proxy for disgust sensitivity. The results of Study 2 extended this finding by demonstrating that individual differences in self-reported sense of smell influence how individuals react to a disgusting olfactory stimulus. Those who reported having a better sense of smell (or better insight into their olfactory ability) found a disgusting smell significantly more noxious as compared to participants reporting having a poor sense of smell (or poor insight into their olfactory ability). The current findings suggest that a one-item measure of self-reported sense of smell may be an effective tool in disgust research.

Keywords: disgust sensitivity, disgust, olfaction, individual differences

When designing studies, finite resources cause tough decisions for researchers – which measures does one include and which does one exclude? Brief measures of individual differences can be a reasonable compromise when faced with this all too familiar dilemma. Despite their psychometric flaws, brief or single-item measures are attractive because they are less boring and fatiguing than large scales and can be flexibly incorporated into many types of study designs (Robins, Hendin, & Trzesniewski, 2001). Moreover, single-item measures have been used to assess a wide variety of constructs including affect (e.g., Russell, Weiss, & Mendelsohn, 1989; Gosling, Rentfrow, & Swann, 2003). The purpose of the current studies was to evaluate a single-item measure relevant to disgust – self-reported sense of smell.

Disgust is thought to have evolved as an oral rejection response to discourage the ingestion of noxious substances (e.g., Rozin, Haidt, McCauley, & Imada, 1997). Related to this idea, olfaction exacerbates reactions to disgusting stimuli. For example, olfactory cues facilitate the recognition of disgusting facial expressions (but not other facial expressions) at both behavioral and neural levels (Seubert et al., 2010). Disgust sensitivity appears to have parallel effects on brain activity (Calder et al., 2007; Schienle, Schäfer, Stark, Walter, & Vaitl, 2005; Stark et al., 2005) and behavior (Olatunji, Haidt, McKay, & David, 2008) in the presence of disgusting stimuli. Because of the parallel effects of olfaction and disgust sensitivity, we had two central predictions. First, that individuals' metacognitive insight into their olfactory ability (i.e., self-reported sense of smell) would relate positively to disgust sensitivity (Studies 1 and 2). To test this hypothesis, we examined the bivariate correlations between self-reported sense of smell and disgust sensitivity (both total scores and subscale scores) in each study. Further, to give a more potent test of this hypothesis, we then conducted the same set of analyses combining the data from both studies. Second, we predicted that sense of smell would moderate disgust reactivity. To test this hypothesis, we examined the effects of a smell manipulation, self-reported sense of smell, and their interaction on participant's ratings of the smell of the room they were in. Specifically, we expected participants who report having an especially good sense of smell to be significantly more reactive to a disgusting olfactory stimulus

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than those who report having an especially poor sense of smell (Study 2).

Study 1

Method

Participants

Three hundred twenty-two undergraduate students (181 females) participated in exchange for credit toward a course requirement. After the consent process, participants were ushered into individual cubicles to complete the study on computers using DmDx software (Forster & Forster, 2003). This study was approved by the Texas A&M University Institutional Review Board (IRB).

Procedure and Materials

Participants were told the purpose of the study was to assess personality traits that may predict attitude formation and how personality and attitudes relate to opinions on various topics. Participants responded to the questions of interest in the current report (i.e., about olfaction and disgust sensitivity) in conjunction with other self-report questionnaires in order to disguise the purpose of the current study.

Self-Reported Sense of Smell

Participants rated their sense of smell using a single item (i.e., "How would you rate your sense of smell?"). Participants responded using a 7-point scale from 1 = *poor* to 7 = *excellent*. The average rating was 5.23 (*SD* = 1.24).

Disgust Sensitivity

Disgust sensitivity was assessed via the 21-item three-domain disgust scale (Tybur, Lieberman, & Griskevicius, 2009). This scale assesses disgust sensitivity across three functional domains: pathogen, sexual, and moral disgust. Participants responded to each item using a 7-point scale from 1 = *not at all disgusting* to 7 = *extremely disgusting*. The average disgust sensitivity composite score was 3.89 (*SD* = 0.85, α = .85).

Results and Discussion

Our first hypothesis was that disgust sensitivity would relate positively to self-reported sense of smell. It did. Participants who reported having a better sense of smell also scored higher on the three-domain disgust scale, $r(323) = .12$, $p = .03$, 95% CI [.001, .227].[1] Specifically, self-reported sense of smell was modestly associated with greater pathogen disgust, $r(322) = .17$, $p = .003$, 95% CI [.06, .28], weakly related to greater sexual disgust, $r(322) = .11$, $p = .05$, 95% CI [−.01, .22], and unrelated to moral disgust, $r(322) = -.06$, $p = .32$, 95% CI [−.16, .05]. Descriptive statistics and bivariate correlations are reported in Table 1.

Table 1. Descriptive Statistics and Bivariate correlations among variables in Study 1

	M	*SD*	1	2	3	4	5
1. Smell	5.23	1.25	–				
2. TDDS	3.91	0.82	.12*	–			
3. Moral	4.18	0.94	−.06	.66**	–		
4. Sexual	3.91	1.39	.11*	.82**	.35**	–	
5. Pathogen	3.63	1.00	.17*	.66**	.20**	.31**	–

Note. Smell = Self-reported sense of smell, TDDS = Three-Domain Disgust Scale Total Score; *$p < .05$, **$p < .01$ (all two-tailed).

Previous research has demonstrated that women report being more sensitive to disgusting stimuli than men are (e.g., Haidt, McCauley, & Rozin, 1994; Olatunji, Sawchuk, Arrindell, & Lohr, 2005; Tybur, Bryan, Lieberman, Hooper, & Merriman, 2011). Consistent with prior research, women ($M = 4.10$, $SD = 0.79$) reported being more sensitive to disgust than men ($M = 3.67$, $SD = 0.80$), $t(320) = 4.83$, $p < .001$, $d = 0.54$. Women ($M = 5.38$, $SD = 1.15$) also reported having a better sense of smell than men ($M = 5.04$, $SD = 1.36$), $t(320) = 7.87$, $p < .001$, $d = 0.27$. Thus, sex differences in self-reported sense of smell parallel sex differences in disgust sensitivity.

Study 2

The first goal of Study 2 was to replicate the correlation between disgust sensitivity and sense of smell observed in Study 1. The second goal of this research was to examine the ability of self-reported sense of smell to modulate reactions to disgusting stimuli. In service of this goal, participants were randomly assigned to complete questionnaire packets in a neutral smelling room or a disgusting smelling room. Embedded within these packets were our key measures. Participants rated their olfactory ability, completed a questionnaire assessing disgust sensitivity (Tybur et al., 2009), and rated the pleasantness of the smell of the room. We predicted that self-reported sense of smell would modulate reactions to a disgusting stimulus. Specifically, we predicted that participants who report having a better sense of smell would report that the room smells significantly worse than their counterparts who report having a poor sense of smell. Stated another way, we predicted that self-reported sense of smell would predict disgust reactivity.

[1] All confidence intervals in both studies based on 5,000 bootstrap samples.

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Method

Participants

One hundred eighteen undergraduate students (82 female) participated in exchange for credit toward a course requirement. One participant did not complete the self-reported sense of smell item leaving 117 participants for analysis. Participants were randomly assigned to work in neutral smelling classroom or a disgusting smelling classroom. This study was approved by the Texas A&M University IRB.

Procedure and Materials

Participants were led to believe the purpose of the study was to assess personality traits that may predict attitude formation and how personality and attitudes relate to opinions on various topics. Participants then completed the same self-reported sense of smell item embedded within a demographic questionnaire and disgust sensitivity measure as Study 1.

Smell Manipulation

The study was completed in two adjacent classrooms on two successive Saturdays. On the first Saturday, classroom A was randomly assigned to be the disgusting room while classroom B was randomly assigned to be the neutral smelling room. On the next Saturday, this was reversed. As participants arrived for the study, they were randomly assigned to either classroom A or B in a between-subjects design. In the *disgusting room*, participants were told that due to a recent series of floods in the building, the pipes were periodically emitting noxious odors. After the consent process, the experimenter sprayed two pumps of "Liquid ASS," a novelty odor liquid on a white board and proceeded to "clean" the white board. To avoid suspicion, the "Liquid ASS" was disguised as a bottle of white board cleaner. In the control condition, all instructions and procedures were identical with one notable exception: The white board was cleaned with actual white board cleaner. This novelty odor spray has been used effectively to evoke disgust in past research (e.g., Tybur, Bryan, Magnan, & Hooper, 2011). Next, participants received a packet containing a writing task[2] and a questionnaire that asked them to rate the friendliness of the experimenter, their interest in the study, the pleasantness of the lighting, temperature, and smell of the room.

Results and Discussion

Consistent with our first hypothesis and Study 1, disgust sensitivity was positively correlated with self-reported sense of smell, $r(116) = .19$, $p = .04$, 95% CI [.01, .36]. This association was driven by disgust in the physical domain, primarily sexual disgust, $r(118) = .18$, $p = .05$, 95% CI [−.01, .37]. Neither moral nor sexual disgust were related to self-reported sense of smell, $p > .2$. Descriptive statistics and bivariate correlations are reported in Table 2.

Like Study 1, women ($M = 4.16$, $SD = 0.71$) reported being more sensitive to disgust than men ($M = 3.47$, $SD = 0.85$), $t(114) = 4.47$, $p < .001$, $d = 0.88$. A marginal sex difference did emerge for self-reported sense of smell, women ($M = 5.59$, $SD = 0.99$) reported having a better sense of smell than men ($M = 5.21$, $SD = 1.20$), $t(114) = 1.76$, $p = .08$, $d = 0.35$.

To further test this first hypothesis, we combined the data from Studies 1 and 2 ($N = 440$). In this combined analysis, once again self-reported sense of smell was positively associated with disgust sensitivity, $r(118) = .14$, $p = .004$, 95% CI [.04, .23]. This association was driven by physical disgust as sense of smell was positively associated with both sexual disgust $r(440) = .13$, $p = .006$, 95% CI [.03, .23] and sexual disgust $r(440) = .15$, $p = .006$, 95% CI [.05, .23]. Again, moral disgust was unrelated to sense of smell, $p > .7$.

To test our second hypothesis that sense of smell moderates participants' reactions to a disgusting stimulus, we regressed smell condition, self-reported sense of smell (centered), and their interaction on participants' rating of the pleasantness of the room's smell. The main effect of smell condition was significant, such that the smell of the disgusting room was rated significantly more unpleasant ($M = 1.74$, $SD = 0.96$) compared to the neutral control room ($M = 4.93$, $SD = 1.08$), $B = -3.15$, $t(115) = 16.95$, $p < .001$, $d = -3.12$, 95% CI [−3.53, −2.77] suggesting that our disgust manipulation was effective. The main effect of self-reported sense of smell was also significant, $B = .27$, $t(115) = 2.48$, $p = .01$, 95% CI [.056, .469]. More importantly, the interaction between the smell manipulation and self-reported sense of smell was significant, $B = -.69$, $t(115) = -3.76$, $p < .001$, 95% CI [−1.05, −0.34].

Critically, this interaction remains significant when controlling for participant sex and its interaction with both condition and sense of smell, $B = -.95$, $t(115) = -4.16$, $p < .001$, 95% CI [−1.41, −0.48]. Moreover, the interaction did not influence ratings of the friendliness of the experimenter, their interest in the study, and the pleasantness of the lighting, and temperature, $ps > .10$.

We examined the effects of our disgust manipulation on ratings of the pleasantness of the room's smell in two ways. First, we examined the effects of the smell manipulation on ratings of the pleasantness of the room's smell for participants at ± 1 *SD* from the mean sense of smell score. This analysis revealed that as expected, both participants with a stronger sense of smell (+1 *SD*), $t(114) = -15.09$, $p < .001$, and those with a weaker sense of smell

[2] This writing task asked participants to write about death or a control topic (uncertainty). The critical interaction continued to be significant when this manipulation was included in the model, $B = -.75$, $t(115) = -2.875$, $p = .005$, 95% CI [−1.35, −0.15].

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Table 2. Descriptive Statistics and Bivariate correlations among variables in Study 2

	M	*SD*	1	2	3	4	5
1. Smell	5.47	1.06	–				
2. TDDS	3.94	0.82	.19*	–			
3. Moral	4.10	1.00	.11	.63**	–		
4. Sexual	4.05	1.45	.17*	.83**	.32**	–	
5. Pathogen	3.65	1.02	.09	.62**	.10	.29**	–

Note. Smell = Self-reported sense of smell, TDDS = Three-Domain Disgust Scale; *$p < .05$, **$p < .01$ (all two-tailed).

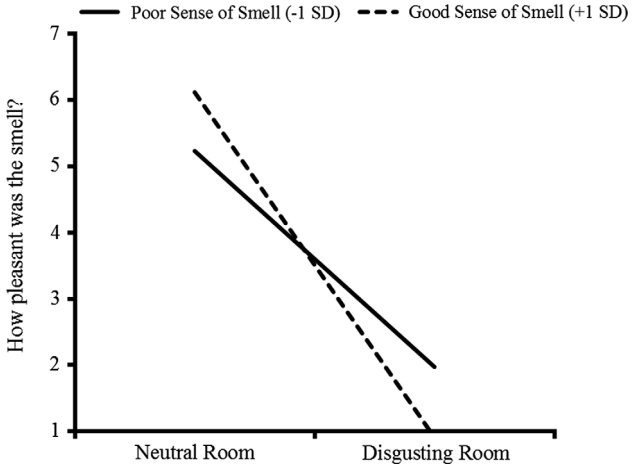

Figure 1. The magnitude of the difference in ratings of the neutral versus disgusting room was significantly larger for those with a stronger sense of smell (Study 2).

(−1 *SD*), $t(114) = -8.63$, $p < .001$, reported that the neutral room smelled better than the disgusting smelling room. However, the magnitude of the difference in ratings was significantly larger for those with a stronger sense of smell, suggesting that they may be more reactive to disgusting olfactory stimuli (see Figure 1). Second, we used a within-cell regression approach to probe the nature of the interaction. For participants in the disgusting smelling room, self-reported sense of smell was associated with stronger negative reactions to the smell of the room, $B = -0.42$, $t(51) = -3.11$, $p = .003$. By contrast, in the neutral smelling room, self-reported sense of smell was associated with a more favorable reaction to the smell of the neutral room, $B = 0.27$, $t(62) = 2.32$, $p = .023$ (see Figure 2).

We ran a parallel regression model with disgust sensitivity. There was a main effect of smell condition, the smell of the disgusting room was rated significantly more unpleasant compared to the neutral control room, $B = -3.20$, $t(115) = -16.83$, $p < .001$. The interaction between smell condition and disgust sensitivity was not significant, $B = .38$, $t(115) = 1.64$, $p = .10$. Moreover, the interaction did not influence ratings of the friendliness of the experimenter, or their interest in the study, $ps > .10$. Unexpectedly,

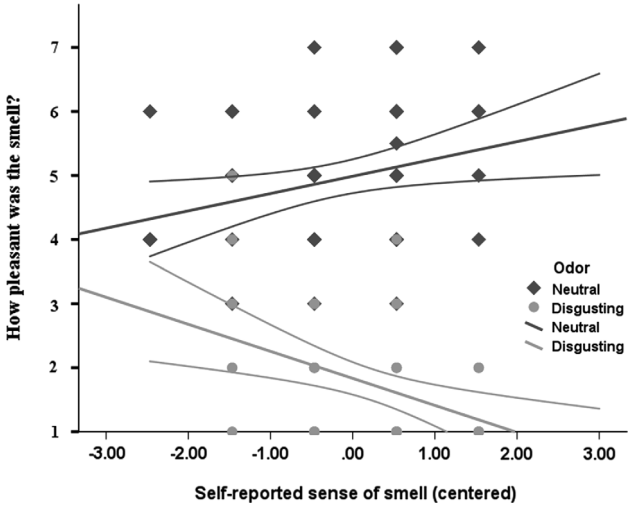

Figure 2. The relationship between self-reported sense of smell and pleasantness ratings of the room separately for the neutral and disgusting smelling room (Study 2). Curved lines denote 95% confidence intervals around the fit lines for each group.

the Condition × Disgust Sensitivity interaction did influence their ratings of the pleasantness of the lighting, $B = -3.20$, $t(115) = -16.83$, $p < .001$, and temperature, $B = 0.59$, $t(115) = 2.54$, $p = .01$. These interactions revealed that highly disgust sensitive participants in the disgusting smelling room reported that the room's lighting and temperature were more pleasant than those in the neutral smelling room, $ts = 2.24$ and 1.88 respectively, $ps = .03$ and .06 respectively. No effects were observed for participants low in disgust sensitivity.

General Discussion

Consistent with our predictions two studies demonstrated that disgust correlates with self-reported sense of smell. Studies 1 and 2 demonstrated from an individual difference perspective, that trait-like differences in disgust relate to self-reported sense of smell. This association was driven by physical forms of disgust: sexual disgust and pathogen disgust. However, the association between self-reported sense of smell and disgust sensitivity is small, suggesting that it is likely not a good proxy for disgust sensitivity. The results of Study 2 extended this finding by demonstrating that individual differences in self-reported sense of smell influence how individuals react to a disgusting olfactory stimulus. Those who reported having a better sense of smell found a disgusting smell significantly more noxious as compared to participants reporting having a poor sense of smell (or poor insight into their olfactory ability). An opposite pattern was observed in the neutral smelling room.

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Furthermore, a disgust sensitivity measure did not predict reactions to the noxious odorant, suggesting that this one item measure of metacognitive insight into one's sense of smell may be a better predictor of disgust reactivity than larger, multi-item measures of disgust sensitivity.

These results are consistent with past research linking self-reported olfactory ability to olfactory performance using a 34-item self-report questionnaire (Smeets, Schifferstein, Boelema, & Lensvelt-Mulders, 2008). Smeets and colleagues found that higher scores on their multi-item measure related positively to both a one-item measure of olfactory ability similar to the one used in the current research and performance on an olfaction task – the Sniffin' Sticks test (Hummel, Sekinger, Wolf, Pauli, & Kobal, 1997). The odorants used on the Sniffin' Sticks test are mostly familiar and pleasant odors (e.g., orange, peppermint) and thus the work by Smeets and colleagues cannot speak to how metacognitive insights into olfactory ability influence reactions to noxious odorants. The current work fills that void. Perhaps more importantly, the current findings suggest that a one-item measure of self-reported sense of smell may be an effective tool in disgust research. To start, it may be a useful screening tool for those aiming to recruit persons that are particularly reactive to disgusting stimuli or even a subtle or implicit measure of disgust reactivity. For these purposes, it may be even more effective than a standard measure of disgust sensitivity. However, future studies should examine the generalizability of these results by implementing disgust manipulations that are not tied to olfaction and, to that end, continue to probe the utility of this single-item measure in disgust research.

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