Core disgust is attenuated by ingroup relations

Stephen D. Reicher[a], Anne Templeton[a], Fergus Neville[b], Lucienne Ferrari[c], and John Drury[c,1]

[a]School of Psychology and Neuroscience, University of St Andrews, Fife KY16 9JP, United Kingdom; [b]School of Medicine, University of St Andrews, Fife KY16 9JP, United Kingdom; and [c]School of Psychology, University of Sussex, Brighton BN1 9QH, United Kingdom

Edited by Susan T. Fiske, Princeton University, Princeton, NJ, and approved January 26, 2016 (received for review August 26, 2015)

We present the first experimental evidence to our knowledge that ingroup relations attenuate core disgust and that this helps explain the ability of groups to coact. In study 1, 45 student participants smelled a sweaty t-shirt bearing the logo of another university, with either their student identity (ingroup condition), their specific university identity (outgroup condition), or their personal identity (interpersonal condition) made salient. Self-reported disgust was lower in the ingroup condition than in the other conditions, and disgust mediated the relationship between condition and willingness to interact with target. In study 2, 90 student participants smelled a sweaty target t-shirt bearing either the logo of their own university, another university, or no logo, with either their student identity or their specific university identity made salient. Walking time to wash hands and pumps of soap indicated that disgust was lower where the relationship between participant and target was ingroup rather than outgroup or ambivalent (no logo).

disgust | social identity | groups | group processes | coaction

In this paper we are concerned with the impact of social boundaries on the experience of disgust and, more specifically, on the attenuation of disgust within group boundaries. This is of broad significance, being critical to understanding both the functionality of disgust and how group behavior becomes possible.

For many who study disgust, it is a response that leads us to insulate ourselves from those who are foreign to us, whose pathogens may harm us. Thus, the sensual intrusion of others upon the self (their sight, smell, touch, or taste) leads to an overwhelming desire to reestablish distance (1, 2). This is true at both an individual and a group level. Strangers and members of outgroups are those who provoke most disgust (3–5).

Equally, among those who study relations between groups, there is a longstanding tradition that recognizes the critical role of disgust. In 1928, Park (ref. 6, p. 17) wrote that "racial antipathies are intensified by anything which arouses disgust. For this reason we tend to contract many of our racial antipathies, so to speak, through the nose." Later, in his classic text on prejudice Allport affirmed that "the 'argument by odor' is so pervasive that it merits further examination" (ref. 7, p. 137). It has taken a while for such examination to occur, but recently it has been shown that invoking disgust invokes dehumanization, bias, and extreme forms of prejudice against outgroups (8, 9).

In sum, it is well established that disgust plays a significant role in keeping groups apart, especially from those who, we believe, could contaminate us (10, 11). It is easy to see how this could be highly functional in protecting us from disease. However, in other ways it is highly dysfunctional. High levels of disgust impede people from coming together and cooperating. Hence, lack of disgust is essential in keeping groups together and enabling them to work together effectively.

Drawing on self-categorization theory (12), for which group formation is based on people defining themselves in terms of a common category membership (e.g., "we are Americans" or "we are psychologists") and leads fellow group members to be included as part of an extended social self, we suggest that this sense of commonality leads to lowered disgust, which in turn facilitates interaction. In the same way that we see our own children as less "other" and hence are less disgusted by such things as removing their diapers (13), so, we suggest, we cease to see ingroup peers as other and cease to be disgusted by them.

It is important to stress here that we are concerned with disgust that arises out of the embodied presence of the other [so-called "core" disgust (2)], not the sense of moral disgust or sexual disgust invoked by the idea of the other. There may be connections between these, but it is generally recognized that they differ from each other along a number of dimensions (14). For instance, moral disgust is more akin to anger (15); "core" and moral disgust are associated with different patterns of autonomic response (16). More generally, Tybur et al. (17, 18) propose that the different types of disgust have different distal determinants and are proximally associated with different information processing systems. So, whereas Harris and Fiske (19) show that moral disgust is limited to certain extreme outgroups, and that therefore we do not necessarily experience less moral disgust for ingroup members, it remains to be shown how group boundaries relate to the experience of "core" physical disgust.

Here, drawing both on the recognition that bodily waste products are the most potent elicitors of disgust (20, 21) and also Allport's (7) concern with the "argument by odor," we present two studies that investigate whether body odor is less disgusting when it is associated with an ingroup member as opposed to an outgroup member or an undefined individual. Secondarily, we also address whether lowered ingroup disgust arises through increased similarity and whether it facilitates increased interaction.

Study 1

Introduction. In this study, student participants from Sussex University were asked to rate a sweaty t-shirt which bore the emblem of a university different from their own (Brighton University). Either their personal identity was made salient, their specific university identity was made salient (in which case the source of the t-shirt was outgroup), or else their broader identity as a student was made salient (in which case the source was ingroup). Our argument is specifically that disgust is attenuated when a source is ingroup rather than that it is accentuated when the source is outgroup. Accordingly, it was predicted that disgust will be lower in the broad "student identity" condition than in

Significance

Two experiments showed that where there is shared identity with others in a group the disgust experienced at smelling their sweat is significantly attenuated, and willingness to interact with them increased, compared with when the sweat was from an outgroup member or another individual. This difference is explained by the similarity to self of ingroup members. The analysis points to both the importance of social group boundaries in moderating the experience of "core" physical disgust and also the importance of disgust in the analysis of basic group processes, including the ability of group members to cohere and work together.

Author contributions: S.D.R., A.T., and J.D. designed research; A.T. and L.F. performed research; S.D.R., A.T., F.N., L.F., and J.D. analyzed data; and S.D.R., A.T., F.N., and J.D. wrote the paper.

The authors declare no conflict of interest.

This article is a PNAS Direct Submission.

[1]To whom correspondence should be addressed. Email: j.drury@sussex.ac.uk.

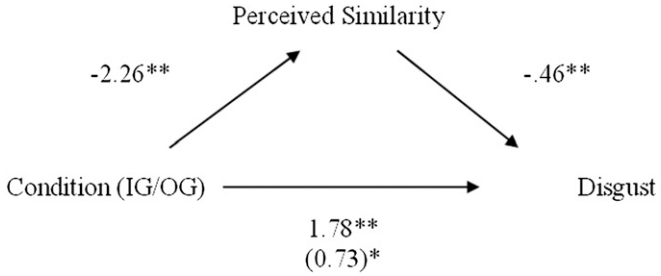

Fig. 1. Perceived similarity as a mediator of the relationship between condition (ingroup/outgroup) and disgust. *$P < 0.05$, **$P < 0.01$ Values represent unstandardized regression weights.

either the "university" or the "personal" identity conditions, which themselves should not differ.

Measures were also taken of their perceived similarity to the source (t-shirt wearer) and willingness to interact with the source. It was predicted that similarity would mediate the relation between group condition and disgust and that disgust would mediate the relationship between condition and desire for interaction.

Results.

Manipulation checks. Sussex University identity salience differed between conditions [interpersonal, mean (M) = 2.27, SD = 0.97; outgroup, M = 4.73, SD = 1.03; ingroup, M = 4.49, SD = 1.28, $F(2, 42) = 15.78$, $P < 0.001$, $\eta^2 = 0.43$]. Post hoc Tukey tests revealed that scores were significantly greater in the outgroup and ingroup conditions than in the interpersonal condition ($P < 0.001$). There was no significant difference between the outgroup and ingroup conditions.

Student identity salience also differed between conditions [interpersonal, M = 2.20, SD = 0.93; outgroup, M = 4.18, SD = 1.28; ingroup, M = 5.16, SD = 1.41, $F(2, 42) = 22.67$, $P < 0.001$ $\eta^2 = 0.52$]. Post hoc Tukey tests revealed that scores were significantly higher in the outgroup and ingroup conditions than the interpersonal condition (both $P < 0.001$). There was no significant difference between the outgroup and ingroup conditions.

Finally, awareness of the Brighton University logo on the t-shirt was near ceiling (M = 6.67, SD = 0.67).

Effects of condition on disgust. There was a significant effect of condition upon self-reported disgust [interpersonal, M = 5.33, SD = 0.44; outgroup, M = 4.74, SD = 0.91; ingroup, M = 3.26, SD = 1.02, $F(2, 42) = 25.09$, $P < 0.01$, $\eta^2 = 0.54$]. As predicted, post hoc Tukey tests revealed that the disgust score was lower in the ingroup condition than in either the outgroup or interpersonal conditions (both $P < 0.001$) and that there was no significant difference between the interpersonal and outgroup conditions.

Similarity as a mediator of disgust. We first analyzed the effect of condition on similarity ratings and found a significant difference [interpersonal, M = 2.84, SD = 1.05; outgroup, M = 2.91, SD = 1.03; ingroup, M = 5.13, SD = 0.92, $F(2, 42) = 25.17$, $P < 0.001$, $\eta^2 = 0.55$]. Post hoc Tukey tests revealed that perceived similarity was significantly greater in the ingroup condition than in the other two conditions (both $P < 0.001$), but there was no difference between the outgroup and interpersonal conditions.

On the basis of this finding we then collapsed the three conditions into two—ingroup vs. noningroup (i.e., interpersonal + outgroup)— and then examined whether similarity mediated the effect of condition on disgust. All mediation analyses were conducted using the Hayes (22) PROCESS macro. Results based on 5,000 bootstrapped samples indicated that there was a significant indirect effect of condition on disgust through perceived similarity: $b = 1.05$, bias-corrected and accelerated (BCa) confidence intervals (CI) [0.33, 2.12]. Because zero is not in the 99% confidence interval, this is significantly different from zero at $P < 0.01$. This represents a large effect, $\kappa^2 = 0.40$, 95% BCa CI [0.14, 0.63]* (Fig. 1).

Disgust as a mediator of interaction. We first analyzed the effect of condition on ratings of desired interaction and found a significant difference [interpersonal, M = 2.38, SD = 0.64; outgroup, M = 2.64, SD = 0.94; ingroup, M = 3.96, SD = 1.37, $F(2, 42) = 10.10$, $P < 0.01$, $\eta^2 = 0.33$]. Post hoc Tukey tests revealed that perceived similarity was significantly greater in the ingroup condition than in the other two conditions (both $P < 0.001$). There was no difference between the outgroup and interpersonal conditions.

Next, we again created two conditions— ingroup and noningroup— and examined whether disgust mediated the effect of condition on interaction. Results based on 5,000 bootstrapped samples indicated a significant indirect effect of condition on interaction through disgust: $b = -1.37$, BCa CI [−2.72, −0.70]. This represents a large effect, $\kappa^2 = 0.47$, 95% BCa CI [0.24, 0.67] (Fig. 2).†

Discussion. Both our main and our subsidiary predictions are supported by this study. We found that when the source was included as part of a common ingroup (a fellow student), the level of disgust was attenuated compared with when the source was either a separate individual or a member of a separate group (and, moreover, that the level of disgust in these two latter conditions did not differ). We also found that the effect of ingroup membership in lowering disgust was mediated by perceived similarity and that lowered disgust mediated the effect of ingroup membership on social interaction.

However, any conclusions must be tempered by three considerations. First, manipulation checks revealed no significant differences on measures of either "Sussex University" identity or of "student" identity in either of the group conditions. However, post hoc scales of identification are notoriously reactive (the mere act of measurement can prime a previously nonsalient identification). Moreover, our analyses (notably the effect of condition on perceived similarity) are consistent with the claim that identity has been manipulated, and such a claim provides a comprehensive and parsimonious explanation of results.

Second, although our design involves keeping the identity of the source constant and thereby rules out explanations relating to the status or else the stereotypic content of that source, it does involve variability in the identity of participants. Therefore, the results might be explained in terms of the stereotypic content of participant identity. That is, it is possible that "individual identity," "Sussex identity," and "student identity" invoke different standards concerning personal hygiene, leading to different levels of disgust at exposure to body odors. It would be preferable to have a design that unconfounds ingroup/outgroup relations from the specific identity of the ingroup.

Third, our findings are based on self-reports of disgust, which are open to several biases. It would be preferable to use behavioral measures.

Study 2

Introduction. The second study differed in two respects from the first. First, we manipulated the identity of the source as well as the identity of the participants. Participants, who were St Andrews University students, either had their specific "St Andrews student" identity or else their broad "student" identity

*We also conducted an alternative mediation analysis treating disgust as the mediator between condition and perceived similarity. Results based on 5,000 bootstrapped samples indicated a significant indirect effect: $b = -1.12$, BCa CI [−2.54, −0.33]. This represents a large effect: $\kappa^2 = .38$, 95% BCa CI [0.14, 0.61].

†We also conducted an alternative mediation analysis treating desired social interaction as the mediator between condition and disgust. Results based on 5,000 bootstrapped samples indicated a significant indirect effect of experimental condition on disgust through interaction: $b = 0.77$, BCa CI [0.23, 1.76]. This represents a smaller effect ($\kappa^2 = .36$) than for our predicted model ($\kappa^2 = .47$) with interaction mediating the relationship between condition and disgust.

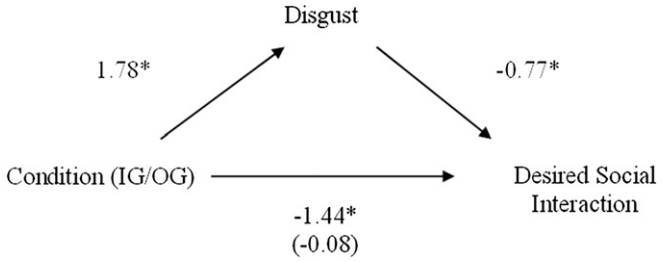

Fig. 2. Disgust as a mediator of the relationship between experimental condition (ingroup/noningroup) and desired social interaction. *$P < 0.001$. Values represent unstandardized regression weights.

made salient. Then they had to smell a sweaty t-shirt that either had a St Andrews University logo, a Dundee University logo (a local "rival" university, equivalent to Brighton University in study 1), or no logo. If the critical determinant of disgust ratings is the categorical relationship between judge and source, then we would find attenuated disgust for the Dundee t-shirt in the "student" as opposed to the "St Andrews" identity conditions (because the source is ingroup in the former and outgroup in the latter), but no differences in disgust ratings for the St Andrews t-shirt in these two identity conditions (because the source is ingroup in both conditions). If, however, the results derive from the norms of the different groups, then we would find differences in disgust ratings between the two identity conditions to occur irrespective of which t-shirt is smelled. This design therefore unconfounds the effects of categorical relations from those of group identity.

Second, this study employs behavioral measures. Participants were asked to smell the t-shirt then walk over to a table on which a hand sanitizer had been placed, dispense some sanitizer, and wash their hands. Because people seek to distance themselves from disgust-inducing phenomena (e.g., see ref. 17) and also these produce enhanced hygiene behavior (21, 23), we reasoned that greater disgust would be reflected in faster walking, more pumps, and longer hand washing.

Results.

Preliminary analyses. We carried out two preliminary analyses. The first looked at gender and revealed no effect on any of the dependent measures. Accordingly, gender was not included as a factor in the main analyses. The second analysis was undertaken to ensure that time taken in smelling the t-shirt was constant across conditions and therefore could be ruled out as an explanation of the effect of condition on other variables. The findings confirmed that there were no main effects of condition or interactions on how long participants smelled the t-shirt.

Time spent walking to the hand sanitizer. There was a significant main effect of t-shirt [St Andrews, M = 6.06, SD = 1.76; Dundee, M = 4.52, SD = 1.50; plain, M = 4.09, SD = 0.69, $F(2, 79) = 17.12$, $P < 0.001$, $\eta^2 = 0.30$]. Post hoc Tukey tests revealed that participants smelling a St Andrews University t-shirt took significantly longer to walk to the hand sanitizer than participants who smelled a Dundee University or plain t-shirt (both $P < 0.001$). There was no significant difference in time walking between the Dundee University and plain t-shirt conditions. This main effect was qualified by a significant interaction between t-shirt and identity salience: $F(2, 79) = 4.22$, $P = 0.02$, $\eta^2 = 0.10$ (Fig. 3).

An alpha level of 0.0045 was used to control for multiple comparisons in the following statistics. As predicted, planned comparisons demonstrated that for the Dundee t-shirt time walking was significantly longer in the student identity condition (M = 5.30, SD = 1.58) than in the St Andrews identity condition [M = 3.74, SD = 0.94, t (28) = 3.28, $P = 0.003$]. There were no significant differences in time walking for the St Andrews or plain t-shirt conditions (both $P > 0.10$).

Number of pumps of hand sanitizer. The data for this measure were highly nonnormal in distribution [Shapiro–Wilkes (85) = 0.445, $P < 0.001$]. Indeed, all of the participants dispensed either one or two pumps, with the exception of one who dispensed three. Accordingly, it was not appropriate to use parametric analyses. Rather, participants were dichotomized into those who used one pump and those who used more than one pump. Data were then further recoded to represent participation in either an "ingroup" condition (St Andrews identity and St Andrews t-shirt; student identity and St Andrews or Dundee t-shirt) or "outgroup" condition (St Andrews identity and Dundee t-shirt). Participants who smelled the plain t-shirt were omitted from this analysis because their group relationship to the participant was undefined. In the ingroup condition 39 participants used one pump and two used more than one pump. In the outgroup condition, nine people used one pump and six used more than one pump. A Fisher's exact test showed this difference was significant ($P = 0.003$).

Time spent washing hands. There was no significant main effect of t-shirt (St Andrews, M = 13.40, SD = 6.87; Dundee, M = 13.48, SD = 6.28; plain, M = 11.69, SD = 5.23) on time spent washing hands [$F(2, 79) = 0.89$, $P = 0.41$, $\eta^2 = 0.02$] or of salient identity [St Andrews, M = 12.02, SD = 6,23; student, M = 13.69, SD = 5.96, $F(1, 79) = 1.73$, $P = 0.19$, $\eta^2 = 0.02$]. There was no significant interaction between t-shirt and identity conditions: $F(2, 79) = 1.63$, $P = 0.20$, $\eta^2 = 0.04$ (Fig. 4).

Discussion. On two out of three behavioral measures the results indicated that that ingroup relations attenuate disgust (we also included two ratings of disgust, self-rated disgust and observer-rated disgust; the former did not produce the predicted pattern of results whereas the latter largely did. However, because of problems with both measurements, and because of our focus on behavior in the second study, we did not include the details of these findings in *Study 2*, *Results*).[‡]Participants went to wash their hands more quickly and used more soap after smelling a t-shirt that was associated with another individual or a member of another group than when it was associated with an ingroup member. We did not obtain significant results on how long they spent washing their hands. However, this may be simply because once participants had got to the point of applying sufficient soap they felt decontaminated and had no need to apply more.

In this study, unlike the first, we are able to rule out the possibility that our results are down to "hygiene norms" associated with the ingroup because there was no difference between the participant identity conditions when smelling a St. Andrews or a plain t-shirt, only when smelling a Dundee t-shirt. The fact that after smelling the Dundee t-shirt people are quicker when their St Andrews identity is salient than when their student identity is salient also rules out any target stereotype effect. The

[‡]The results for the two measures were as follows. For the self-report ratings of disgust (which were based on a new scale, reduced from the seven items in study 1 to four items and reworded for the sake of simplification and economy) there were no significant findings. In retrospect, we considered that the new scale was inadequate. The items were "I found this t-shirt to be physically repulsive/pleasant/dirty/smelly." Unlike the items used in study 1 the word "disgusting" was not used, nor were its physical correlates (feeling nausea and feeling like vomiting). Indeed, it could be seen as more a scale of pleasantness than disgust.

For the observer ratings of disgust (which involved five independent raters, who were blind to the experimental condition, rating disgust from the facial expression of participants on the videos) there was the predicted interaction between t-shirt and identity salience: $F(2, 75) = 7.72$, $P < .01$, $\eta^2 = .17$. Planned comparisons showed that for the Dundee t-shirt facial disgust was significantly lower in the student identity condition (M = 2.11, SD = 0.67) than in the St Andrews identity condition [M = 2.67, SD = 0.66), t (26) = 2.21, $P = .04$]. There were no significant differences in facial disgust for the St Andrews t-shirt conditions. However the interrater reliability was very low (ICC = .27) and was not greatly improved by excluding any of the judges. Hence, these findings need to be treated with caution.

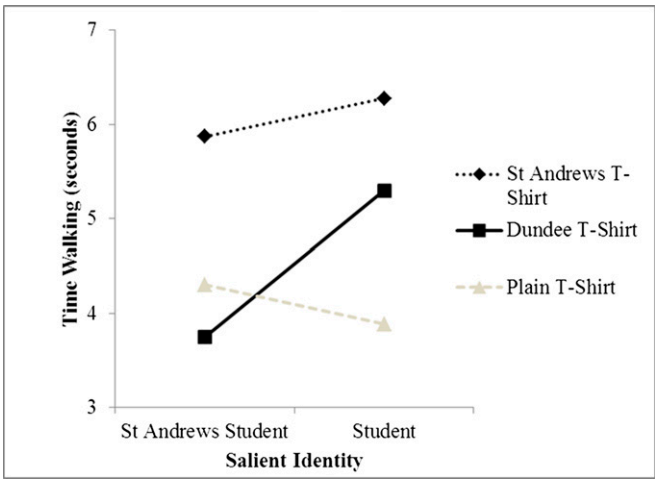

Fig. 3. Time walking to hand sanitizer by experimental condition.

remaining explanation is in terms of category relations. Only when the target is ingroup do people rush less to clean themselves after being exposed to the smell of sweat.

General Discussion

There are four important points arising from our findings. First, in both studies core disgust does not increase for targets labeled as "outgroup" compared with those labeled as another individual. However, it does decrease for targets labeled as ingroup compared with the other two. Hence, our findings point specifically to the attenuation of disgust for ingroup targets rather than the accentuation of disgust for outgroup targets. Second, the findings show specifically that the ingroup relationship is important in terms of attenuating disgust, rather than either the status or stereotypes associated with particular targets [as emphasized by Allport (7)] or cleanliness/disgust standards associated with particular ingroups. Third, the findings hold across both self-report and behavioral measures. Fourth, the attenuation of disgust arises out of the sense that ingroup members are less "other" and facilitates harmonious interaction with them.

Clearly, this is an initial investigation. Firmer conclusions depend upon further studies involving a wider range of social categories and of measures—in particular, behavioral measures of interaction. It is also important to examine whether lowered ingroup disgust has pernicious as well as positive consequences, leading to risky health behaviors (e.g., sharing food and drink) and increasing the possibility of disease transmission in groups (24). This is a particular concern in the emerging field of mass gatherings medicine (25, 26).

Nonetheless, our findings already carry significant implications for both the study of disgust and group processes. On the one hand, they demonstrate the importance of social boundaries in the experience of disgust. Even if one accepts that disgust serves to distance us from others on biological grounds (the avoidance of infection), our perceptions of "otherness" depend upon the social processes by which "otherness" is defined. One of our most powerful findings is that the same target (e.g., a Dundee student) can be either outgroup or ingroup and elicit more or less disgust as a function of whether we define ourselves less or more inclusively (e.g., as "from St. Andrews" or as "a student").

On the other hand, our findings contribute to a growing body of evidence that group identities affect not only social perceptions but also our basic sensual experiences of cold (27), of noise (28), and now of smell. More fundamentally, the studies remind us that groups involve not only a gathering of minds but also of sweaty, smelly, tactile bodies. It is impossible to work with people if you cannot stand their physical presence. Accordingly, understanding of how group life is possible will necessarily remain incomplete without attention to the sensual dimension.

Methods

Study 1.

Participants. Forty-five female students from Sussex University participated in return for entry into a £25 cash draw. This sample size was determined via pilot testing and then used for the subsequent experiment.

Design. All participants smelled a t-shirt bearing the logo of Brighton University (another local university) and had either their personal, Sussex University, or student identity made salient. They then filled in a questionnaire containing measures of perceived similarity to the source, disgust, and willingness to interact.

Materials. The t-shirt was white, medium-sized, and bore a large Brighton University logo. To render it pungent, the t-shirt was worn for a week by a male research assistant both during daily physical exercises and in bed. It was then placed into a tightly sealed plastic container to maintain the odor.

Measures of disgust. The disgust scale ($\alpha = 0.91$) comprised six items that were adapted from the Disgust Sensitivity Scale Revised (29) [e.g., "When I smelt this t-shirt I worried I would vomit" and "I'm indifferent to the smell of this person" (reversed)]. All items on this and the other measures were answered on seven-point Likert scales ranging between Not at all (1) and Very much so (7).

Interaction. Three items ($\alpha = 0.77$) were adapted from Novelli, Drury, and Reicher (30) (e.g., "I would not mind socialising with this person" and "I would like to meet this person").

Perceived similarity. Three items ($\alpha = 0.87$) were devised by the authors: "I felt a sense of similarity with this person," "I feel like I would have nothing in common with this person" (reversed), and "I feel I can identify with this person."

Manipulation checks. Both strength of identification as a Sussex University student ($\alpha = 0.94$) and as a student ($\alpha = 0.97$) were measured using three items adapted from standard scales (31, 32); for example, "The fact that I am a student [at Sussex University] is an important part of who I am." These scales were used as checks for the identity manipulation. We also checked whether participants were aware of the identity of the source by asking "Did you notice the Brighton logo on the t-shirt?"

Procedure. The study took place over 5 d. Independent judges were asked to rate the pungency of the t-shirt each day to confirm that the odor remained consistent throughout the data gathering. They rated the odor consistently high.

To disguise its true purpose, participants were told that the experiment was designed to investigate their perception of pheromones. They were approached opportunistically in communal student areas. Nobody who was approached refused to participate. Identity salience was manipulated by altering the wording of participant information sheets and the heading of the questionnaire. The sheet read "this present study is concerned with the abilities of individuals / Sussex University students / students in pheromone detection compared with others / students from other Universities / non-students" and the questionnaire was headed "Pheromone detection test:

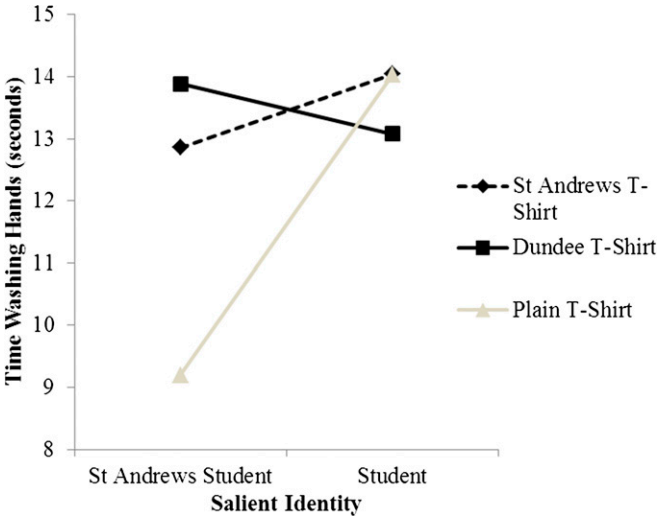

Fig. 4. Time washing hands by experimental condition.

A comparison of individuals / Sussex University students vs. other university students / students vs. non-students." The experimenter verbally explained to participants that they were to have a "big smell" of the t-shirt once the lid was taken off the box and "once you feel you have had a big enough smell of the t-shirt, put the box back down." The box lid was replaced and participants then completed the measures.

Ethics statement. The study protocol was approved by the University of Sussex School of Psychology Research Governance Committee in 2010. All participants provided their written informed consent before participation.

Study 2.

Participants. Ninety students at St Andrews University participated. Participants were excluded if they failed to correctly identify the logo on the t-shirt ($n = 5$). Of the remaining 85 participants, 31 were male and 54 female.

Design. The study had a 2×3 design. Participants were primed to have salient either a St Andrews University student identity or a student identity, before being asked to smell either a St Andrews University, Dundee University, or plain t-shirt. Disgust was measured as follows: time walking to hand sanitizer dispenser, number of pumps of hand sanitizer, time spent washing hands, and self-reported disgust.

Materials. All of the t-shirts were white; one was plain, and the St Andrews and Dundee t-shirts had equivalent-sized navy-blue logos. Each t-shirt was worn by the same female researcher during a strenuous 1-h run, after which they were immediately placed into a tightly sealed plastic container to maintain the odor over the week that the experiment took place.

Measures. All measures were based on the video records, and time measures were based on the time codings on these videos. The person coding the data was blind to which condition participants were in.

Time spent smelling the t-shirt. This was the time taken from the moment participants first put the t-shirt to their faces to when they began moving the t-shirt back down toward the desk.

Time spent walking to hand sanitizer. This was the time taken from the moment participants placed the t-shirt back onto the desk, to the moment they first pressed the pump on the bottle of hand sanitizer. The t-shirt and the hand sanitizer were 6 m apart in all conditions.

Number of pumps of hand sanitizer. This was the number of separate times that the participant pressed down the pump on the sanitizer bottle.

Time spent washing hands. This was the time taken from the moment that participants finished pumping sanitizer to the moment they stopped rubbing their hands together.

Awareness of source. At the end of the questionnaire participants were asked "Did you notice a logo on the t-shirt?" and "If yes, what was the logo?"[§]

Procedure. The study was conducted in the Social Immersion laboratory at St Andrews University, which allows for unobtrusive filming. On arrival, participants were directed to a side room next to the laboratory, where they were told they were participating in a study examining the ability of members of different social groups to extract social information from odors, that they would be asked to smell a t-shirt taken from another study investigating the production of pheromones during exercise, and that they would then be asked to make ratings of the wearer. To manipulate identity, they were then told that we were interested in them as either "St Andrews students" or as "students" and they were asked to note down three things which they thought were the distinctive defining characteristics of St Andrews students/students (33). After this, participants were taken into the main laboratory, where the experimenter indicated the t-shirt that was placed on a table at one end of the laboratory and the hand sanitizer that was across the room. Each participant was given the instruction "When you're ready, you can pick up the t-shirt and smell it to see what information you can get about the owner. There is hand sanitizer on the table if you would like to use it after." After these tasks, participants completed a final questionnaire.

Ethics statement. The study protocol was approved by the University of St Andrews Teaching and Research Ethics Committee in 2011. All participants provided their written informed consent before participation.

[§]This "awareness" check was reworded from study 1 to be less leading. That is, instead of asking "Did you notice the St. Andrews/Dundee logo?" we asked participants to say whether they had noticed the logo and then name it themselves.

1. Rozin P, Fallon AE (1987) A perspective on disgust. *Psychol Rev* 94(1):23–41.
2. Rozin P, Haidt J, McCauley CR (2008) Disgust. *Handbook of Emotions*, eds Lewis M, Haviland Jones JM, Barrett LF (Guilford, New York), 3rd Ed, pp 757–776.
3. Fessler D, Haley K (2006) Guarding the perimeter: The outside-inside dichotomy in disgust and bodily experience. *Cogn Emotion* 20(1):3–19.
4. Miller WI (1998) *The Anatomy of Disgust* (Harvard Univ Press, Cambridge, MA).
5. Navarrete CD, Fessler DMT (2006) Disease avoidance and ethnocentrism: The effects of disease vulnerability and disgust sensitivity on intergroup attitudes. *Evol Hum Behav* 27(4):270–282.
6. Park RE (1928) The bases of race prejudice. *Ann Am Acad Pol Soc Sci* 140:11–20.
7. Allport G (1954) *The Nature of Prejudice* (Addison-Wesley, Reading, MA).
8. Dasgupta N, Desteno D, Williams LA, Hunsinger M (2009) Fanning the flames of prejudice: The influence of specific incidental emotions on implicit prejudice. *Emotion* 9(4):585–591.
9. Taylor K (2007) Disgust is a factor in extreme prejudice. *Br J Soc Psychol* 46(Pt 3): 597–617.
10. Inbar Y, Pizarro DA, Bloom P (2012) Disgusting smells cause decreased liking of gay men. *Emotion* 12(1):23–27.
11. Tapias MP, Glaser J, Keltner D, Vasquez K, Wickens T (2007) Emotions and prejudice: Specific emotions towards outgroups. *Group Process Intergroup Relat* 10(1): 27–39.
12. Turner JC, Hogg MA, Oakes PJ, Reicher SD, Wetherell MS (1987) *Rediscovering the Social Group: A Self-Categorization Theory* (Blackwell, Oxford).
13. Case TI, Repacholi BM, Stevenson RJ (2006) My baby doesn't smell as bad as yours: The plasticity of disgust. *Evol Hum Behav* 27(5):357–365.
14. Pizarro DA, Inbar Y (2015) Explaining the influence of disgust on political judgement: A disease avoidance account. *Social Psychology and Politics*, eds Forgas JP, Fiedler K, Crano WD (Psychology Press, New York), pp 163–172.
15. Gutierrez R, Giner-Sorolla R, Vasiljevic M (2012) Just an anger synonym? Moral context influences predictors of disgust word use. *Cogn Emotion* 26(1):53–64.
16. Ottaviani C, Mancini F, Petrocchi N, Medea B, Couyoumdjian A (2013) Autonomic correlates of physical and moral disgust. *Int J Psychophysiol* 89(1):57–62.
17. Tybur JM, Lieberman D, Griskevicius V (2009) Microbes, mating, and morality: Individual differences in three functional domains of disgust. *J Pers Soc Psychol* 97(1): 103–122.
18. Tybur JM, Lieberman D, Kurzban R, DeScioli P (2013) Disgust: Evolved function and structure. *Psychol Rev* 120(1):65–84.
19. Harris LT, Fiske ST (2006) Dehumanizing the lowest of the low: Neuroimaging responses to extreme out-groups. *Psychol Sci* 17(10):847–853.
20. Nesse RM, Williams GC (1995) *Why We Get Sick* (Times Books, New York).
21. Rozin P, Lowery L, Ebert R (1994) Varieties of disgust faces and the structure of disgust. *J Pers Soc Psychol* 66(5):870–881.
22. Hayes AF (2013) *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach* (Guilford, New York).
23. Curtis V, de Barra M, Aunger R (2011) Disgust as an adaptive system for disease avoidance behaviour. *Philos Trans R Soc Lond B Biol Sci* 366(1563):389–401.
24. Pellerin J, Edmond MB (2013) Infections associated with religious rituals. *Int J Infect Dis* 17(11):e945–e948.
25. Hopkins NP, Reicher SD (2015) The psychology of health and well-being in mass gatherings: A review and an agenda for research. *J Epidemiol Glob Health*, 10.1016/j.jegh.2015.06.001.
26. Memish ZA, Stephens GM, Steffen R, Ahmed QA (2012) Emergence of medicine for mass gatherings: Lessons from the Hajj. *Lancet Infect Dis* 12(1):56–65.
27. Pandey K, Stevenson C, Shankar S, Hopkins NP, Reicher SD (2014) Cold comfort at the Magh Mela: Social identity processes and physical hardship. *Br J Soc Psychol* 53(4): 675–690.
28. Srinivasan N, et al. (2013) Social meaning of ambiguous sounds influences retrospective duration judgments. *Psychol Sci* 24(6):1060–1062.
29. Van Overveld WJM, de Jong PJ, Peters ML, Cavanagh K, Davey GCL (2006) Disgust propensity and disgust sensitivity: Separate constructs that are differentially related to specific fears. *Pers Individ Dif* 41(7):1241–1252.
30. Novelli D, Drury J, Reicher S (2010) Come together: Two studies concerning the impact of group relations on personal space. *Br J Soc Psychol* 49(Pt 2):223–236.
31. Doosje B, Branscombe NR, Spears R, Manstead ASR (1998) Guilty by association: When one's group has a negative history. *J Pers Soc Psychol* 75(4):872–886.
32. Luhtanen R, Crocker J (1992) A collective self-esteem scale: Self-evaluation of one's social identity. *Pers Soc Psychol Bull* 18(3):302–318.
33. Haslam SA, Oakes PJ, Turner JC, McGarty C (1995) Social categorization and group homogeneity: Changes in the perceived applicability of stereotype content as a function of comparative context and trait favourableness. *Br J Soc Psychol* 34(Pt 2): 139–160.