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Guarding the perimeter: The outside-inside dichotomy in disgust and bodily experience

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Blending phenomenological and evolutionary approaches, three studies explored the relationship between the body, the self, and disgust. Study 1 demonstrated that body parts that interface with the environment are sensed more than internal body parts, and are more intimately associated with the self. Studies 2 and 3, exploring the bodily distribution of disgust via organ transplantation scenarios, revealed that (a) transplantation of interface body parts is more disgusting than transplantation of internal parts; (b) others' interface parts elicit greater disgust than others' internal parts; and (c) individual differences in disgust sensitivity manifest primarily in reasoning about interface parts. The outer/inner dichotomy is a fundamental feature of the relationship between body and self, reflecting the adaptive utility of concentrating attention on the interface with the environment. Correspondingly, disgust, the emotion that protects the organism from contamination, is focused on the intersection between the body and the environment.

Disgust, widely recognised as a basic emotion, has become the focus of considerable research. Most contemporary investigations of disgust adopt one of two contrasting theoretical approaches. Viewed from a phenomenological or conceptual perspective, disgust is seen as guarding the self against symbolic pollution from the physical and social worlds (Haidt, McCauley, & Rozin, 1994; Haidt, Rozin, McCauley, & Imada, 1997; Rozin, Haidt, & McCauley, 1999a; Rozin, Haidt, & McCauley, 2000; Rozin, Lowery, Imada, & Haidt, 1999c; Rozin, Nemeroff, Horowitz, & Gordon, 1995). Viewed from an evolutionary perspective, disgust is seen as guarding the

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body against actual pathogens and toxins present in the environment (Curtis, Aunger, & Rabie, 2004; Curtis & Biran, 2001; Fessler & Navarrete, 2003; Wronska, 1990). Arguing for a consilience of phenomenological and evolutionary approaches to disgust, in this paper we explore the experience of this emotion in light of the patterned nature of the relationship between the self and the body. We begin by asking whether the various parts of the body are unequally associated with the self, a possibility that is both phenomenologically plausible and evolutionarily likely.

Experientially and conceptually, there is an intimate association between the self and the body (Bermúdez, Marcel, & Eilan, 1995). However, the body is not a homogenous object, but rather is composed of diverse parts, parts that may vary in the extent to which they are associated with the self. Belk and Austin (1986) obtained the following descending ranking of degree of association with self: eyes, hair, heart, legs, hands, fingers, genitals, skin, nose, knees, chin, kidneys, liver, and throat. With the exception of the heart, an organ having symbolic value in Western cultures, high ranking items in this list are located on the outside of the body. Belk (1990) suggested that the outer parts of the body may be more intimately associated with the sense of self due to our ability to control them, while the opposite is true of the inner parts of the body. However, as suggested by the position of ''genitals'' on Belk and Austin's list, the extent to which a given part of the body is associated with the self may be a product not merely of controllability, but also of sensitivity. Consistent with the basic dichotomy recognised by Belk, the outer parts of the body are generally more sensitive than the inner parts, and such sensitivity is more strongly linked to affect (see Rozin, 1999). Given phenomenologists' claim that disgust is a protector of the self, in order to lay the foundation for an examination of the role of the body in disgust experience, we therefore conducted an Internet survey exploring both (a) the relationship between the ability to sense a body part and its association with the self, and (b) contrasts in this regard between the outer and inner parts of the body.

STUDY 1

Methods

Materials. A focus group of four men and five women (age 19–41, $M = 24$) discussed the relationship between the experience of oneself as an agent or social entity, the experience of one's body, and the relationship between bodily sensations and emotions. Discussions suggested that, in addition to the question of sensation, there are at least two other pathways whereby a part of the body comes to be associated with the self. First, because a person's understanding of who they are is contingent on how others view them, parts of the body that are salient in others' assessments of one come to be associated with one's sense of

self. Second, cultural schemas attach special symbolic meaning to some body parts, linking them closely to the sense of self.

As will be discussed below, a functionalist evolutionary perspective suggests that the key factor underlying Belk's (1990) dichotomy between the outside of the body and the inside of the body is the extent to which the given body part interfaces with the surrounding environment. Viewing the body objectively with an eye toward this distinction, we composed a list of 20 body parts, 10 of which interface with the environment (i.e., are directly exposed to the environment during normal functioning of a healthy body) and 10 of which are internal to the body (i.e., are not directly exposed to the environment during normal functioning of a healthy body). Because we were principally interested in the role of endogenous sensations in the linkage between the body and the self, we excluded many body parts prominent in assessments of either attractiveness or racial or sexual identity. For example, we selected ''nasal passage'' rather than ''nose'' because, although both of these body parts interface with the environment, the latter is an important determinant of attractiveness (and sometimes identity), and hence is likely to often be the focus of self-conscious attention, while the former is not. Last, although they violate this principle, we included ''hair'' and ''skin'' in order to enhance comparability with Belk and Austin's results; for the same reason, we included ''heart'' despite its cultural significance.

Two Internet survey forms were created using a single graphic layout in which the list of 20 body parts was presented next to pull-down 0–100 scales. Both forms began by asking for the participant's age and gender. One form then instructed the participant to use the scales to indicate how important each body part was for the participant's sense of self, defined as your conception of yourself as a unique individual. The other form instructed the participant to use the scales to indicate the extent to which the participant was able to sense or perceive each body part. All participants received both forms; order of presentation was randomised.

Participants. These were recruited through a link labelled: ''Surveys on Body Awareness and the Self'' posted on psychological research clearinghouse websites, and through similar postings to social science-related listservs (list of venues available upon request). Participation was anonymous and unpaid: 473 individuals participated. After discarding data from those who: (a) left portions of either form blank, (b) provided inconsistent answers to the age or gender questions on the two forms, (c) were under age 18, or (d) responded via a computer having the same IP (Internet protocol) address as that of another respondent, we were left with 388 participants (287 women and 101 men, age 18–74, $M = 29.28$).

Results

Two patterns are evident. First, within-subjects analysis reveals that the extent to which an individual senses or perceives a given body part is highly correlated with the degree to which that part is associated with the sense of self. This is true for each organ or tissue (hereafter, for simplicity, ''organ'') (see Figure 1) and across all organs, $r(388) = .690$, $p = .000$. Second, individuals report a greater ability to sense, and a greater association with the self for, those parts of the body that interface with the environment compared with those parts of the body that do not: $t(387) = 36.50$, $p = .000$; and $t(387) = 27.05$, $p = .000$, respectively; see Figure 2. Comparing our results with those of Belk and Austin, in both studies, eyes and hair are highly ranked, followed by finger and genitals. While heart was very highly ranked in Belk and Austin's study, we found that, though it was the highest ranked internal body part, it nonetheless trailed all of the principal interface body parts. Finally, whereas skin followed other interface parts in Belk and Austin's results, our participants ranked skin as second only to eyes in the intimacy of its association with the self.

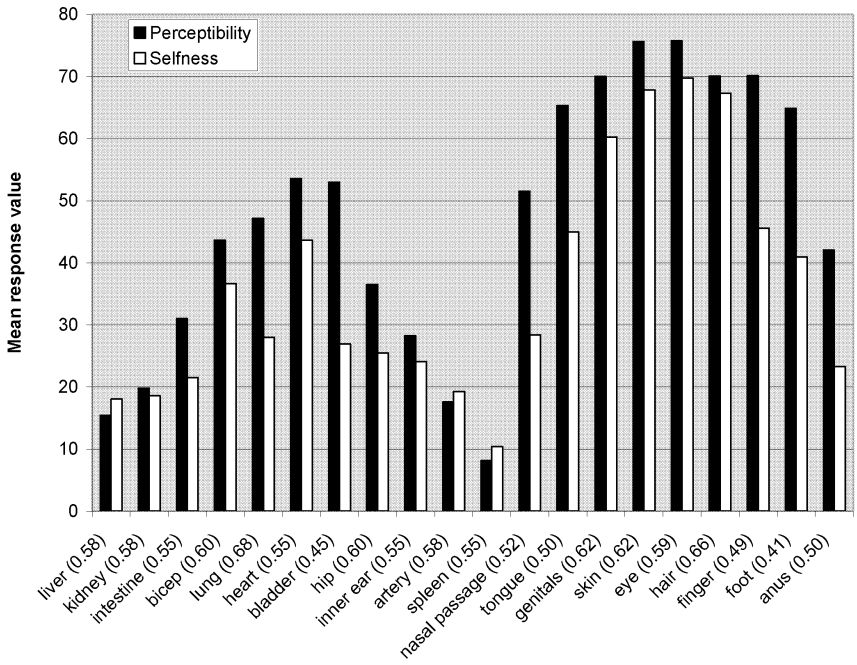

Figure 1. Perceptibility ratings (the degree of awareness subjects report for a given body part) and Selfness ratings (the degree to which subjects report a given body part is associated with their sense of self) for each organ (0–100 scales; associated *r*s in parentheses; all correlations significant at the $p = .01$ level, 2-tailed).

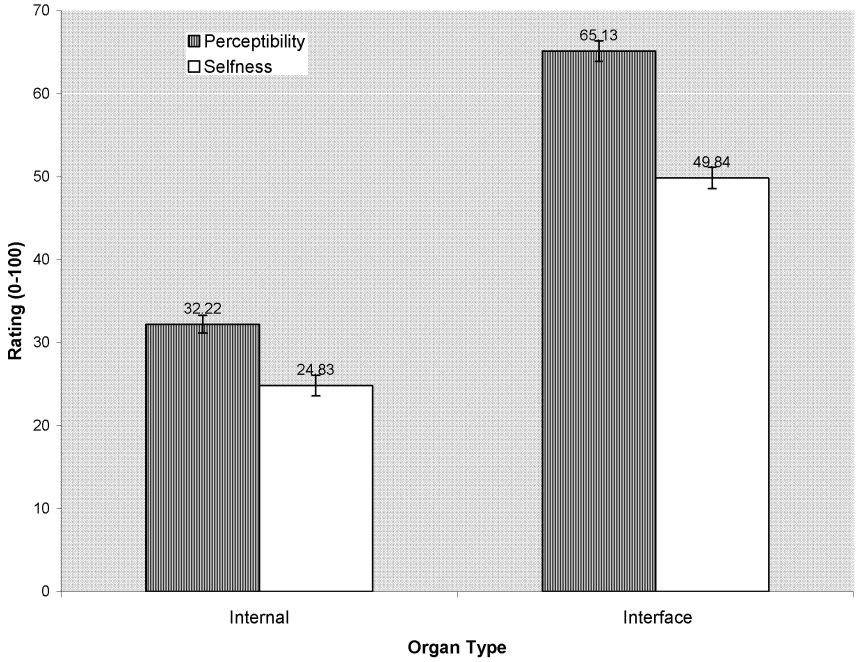

Figure 2. Study 1: Perceptibility and Selfness ratings (0–100 scales) by organ type.

Discussion

The results of Study 1 suggest a first step toward the convergence of phenomenological and evolutionary functionalist approaches, as follows: The conscious mind perceives parts of the body to the extent that it has information about those parts. Although information can be obtained through visual or tactile self-inspection or via feedback from other people, direct sensation is a primary channel in this regard. The extent to which various body parts are sensed (and, relatedly, controllable) is largely a consequence of the degree of innervation in the given body part and the cortical area dedicated to the given part. In general, the richest innervation and proportionately largest command of cortical area is associated with parts of the body that interface with the environment (Allman, 1999; Lee & Woolsey, 1975; Schwartz, Kandel, & Jessell, 2000; Welker & Van der Loos, 1986). This pattern reflects the adaptive importance of dedicating information-processing capacity to tasks involving input from (and action upon) the world around us. From an evolutionary perspective, the chain linking perception, experience, and the self is unlikely to be an accidental consequence of neural architecture—to the extent that it is advantageous to be able to reflect on, reason about, or prospectively envision oneself acting in the world, primary

attention ought to be dedicated to the parts of the body that interface with the environment, as it is here that benefits can first be realised, and costs, including the costs of exposure to pathogens and toxins, can first be avoided.

Disgust, the self, and the body

If, as phenomenologists argue, disgust serves to protect the self from symbolic pollution, then the observation that body parts are differentially associated with the self suggests that similar variation should occur in the experience of disgust—those body parts that are intimately associated with the self should be particularly salient in disgust events. Moreover, if the intimacy of the association between a part of the body and the self is largely contingent on the degree to which the given part is sensed, and if those parts of the body that interface with the environment are more richly perceived than those that do not, then the former class should be more salient in disgust experience than the latter class. Although stemming from different premises, an evolutionary perspective converges on the same conclusion: If disgust serves to shape behaviour so as to prophylactically protect the body against pathogens and toxins present in the environment, then those parts of the body that interface with the environment should loom especially large in disgust experience, since it is here that contact with such hazards takes place. Last, from both a phenomenological and an evolutionary perspective, the differential importance of various body parts should hold true not only with regard to what Rozin et al. (1995) term contamination sensitivity, the degree to which a given body part is experienced as vulnerable to contamination from the environment, but also with regard to what they label contamination potency, the degree to which a given part of another's body is experienced as polluting of the environment.

Rozin et al. (1995) examined disgust reactions to: (a) the prospect of having various parts of one's own body contacted by a contaminant, and (b) the prospect of (indirectly) coming into contact with various parts of another's body. Body apertures were found to be both more vulnerable and more polluting than a non-aperture body part (the skin on the arm). Although the authors found a general symmetry with regard to contamination sensitivity and contamination potency, it is incomplete—the anus, for example, has greater contamination potency than contamination sensitivity, while the reverse is true of the mouth. With the exception of the vagina for females, the mouth is the orifice experienced as most vulnerable to contamination. As noted by the authors, the general salience of apertures is congruent with their role as portals between the self/body and environment and, we would add, their correspondingly rich degree of sensitivity and underlying neural complexity (see also Rozin, 1999). Even more revealing, however, is the authors' finding that disgust increases as a polluted foreign object approaches the open mouth, contacts the tongue, the mouth closes, and the object is chewed (cf. Fallon & Rozin, 1983); in contrast, the

presence of a foreign object in the stomach, while still eliciting disgust, is less disturbing. This is exactly the pattern expected if disgust reactions reflect the neural architecture of the body, an architecture that is the product of natural selection. The lips, mouth, and tongue are among the most richly innervated and cortically supported parts of the body, and, correspondingly, are enormously sensitive and controllable; in comparison, the stomach is impoverished on all counts (Schwartz et al., 2000). This is surely not accidental. In addition to the mere fact of the frequency of incorporation of foreign matter via the mouth, this avenue is particularly vulnerable because the immune system treats ingested material differently from substances incorporated via other routes, dampening immunoreactivity (presumably in order to decrease the likelihood that food allergies will develop) (see Simecka, 1998; Strobel & Mowat, 1998). The mouth is thus a critical portal which must be guarded. In contrast, once material has entered the stomach, avenues for regulating exposure to hazards are severely limited, with vomiting being a costly last resort (Rozin et al., 1995, p. 321). In short, the mouth and the stomach, though linked, are fundamentally different, as the former exemplifies the body-environment interface while the latter is wholly internal, a distinction that has profound consequences for the relative prominence of each in the experience of disgust. To further explore the convergence of phenomenological and evolutionary perspectives suggested by this example, we sought a means of investigating the relative disgust salience of a variety of interface and internal body parts, including, but not limited to, those involved in ingestion.

Viewed phenomenologically, in keeping with the embodied nature of the self, the idea of organ transplantation evokes a rich tapestry of self-related thoughts (examples include self-perceptions of altered preferences and personality attributes, as well as identification with the donor) (Belk, 1990; Sharp, 1995). Consistent with the role of disgust as guardian of the self, this emotion plays a prominent role in attitudes toward the receipt of transplanted organs (Sanner, 2001a, 2001b). These observations suggested to us a method of testing the discrete prediction that the salience of a given body part in the experience of disgust is a function of the extent to which it interfaces with the environment. Asking participants to evaluate possible organ and tissue transplantations has the advantage that it sidesteps a key aspect of disgust experience, one which, while consistent with the theoretical perspective on disgust advanced here, nonetheless precludes the use of scenarios involving mere contact. Violations of the body envelope are a prototypical elicitor of disgust (Curtis et al., 2004; Haidt et al., 1994, 1997; Rozin et al., 1999a), exactly what we should expect if disgust is concentrated on the boundary between the body and the environment. However, this means that it is not possible to use the sort of scenarios employed by Rozin et al. (1995) to compare differences in disgust salience between interface body parts and internal body parts, since contact with many internal body parts is only possible through a violation of the body envelope, a fact that biases the

comparison. In contrast, regardless of its location, the transplantation of any organ or tissue involves a violation of the body envelope, hence reasoning about such events lacks the bias inherent in reasoning about mere contact with a contaminant. Asking participants to consider the possibility of receiving various transplanted organs and tissues thus allows for a clearer examination of the relative salience of different parts of the body in the experience of disgust.

STUDY 2

Methods

Materials. We created an Internet survey which, after requesting age and gender information, instructed participants as follows:

> Imagine that it is now the year 2050. Medical science has advanced to the point that organ and tissue transplants are routine, and doctors prescribe transplantation for a wide variety of medical problems. Using the pull-down menus, indicate how disgusting you think it would be to receive a transplant for each of the organs or tissues listed below.

The same list of 20 body parts used in Study 1 was then presented, with each body part accompanied by a four-item pull-down menu ranging from ''not at all disgusting'' to ''extremely disgusting''.[1]

Participants. Employing the same venues used in Study 1, we recruited unpaid anonymous participants via a link labelled: ''Attitudes Toward Organ Transplantation''. Following similar criteria to those employed in Study 1, 120 of 520 responses were discarded, leaving 250 women, aged 18 to 71 years (*M* 31.73, *SD* 11.57) and 150 men, aged 18–79 (*M* 36.79, *SD* 14.89).

Results

Results supported the prediction that participants would find the prospect of transplantation more disgusting for body parts that interface with the environment. For each body part we calculated a Mean Disgust Rating (MDR) (1 = least disgusting; 4 = most disgusting). Subjects' ratings were analysed using a multivariate analysis of covariance (MANCOVA; age as a covariate). Averaged within each class, scores differed significantly between interface organs (MDR = 2.14) and internal organs (MDR = 1.38), $F(1, 397) = 204.13$, $p = .000$. Consistent with the salience of apertures previously documented by Rozin et al. (1995), anus (MDR = 2.60), tongue (MDR = 2.69), and genitals (MDR = 2.85)

[1] While Nabi (2002) has shown that the term ''disgust'' does not necessarily index core disgust, pilot testing indicated that our participants likely interpreted the term as intended.

received the highest disgust ratings. Nevertheless, apertures do not drive the outside/inside dichotomy, as the difference between internal and interface organ scores remains significant even when these high scorers are excluded (modified MDR = 1.85), $F(1, 397) = 92.81$, $p = .000$.[2] Separate Wilcoxon Signed Rank tests reveal that disgust scores for each of the interface organs listed are significantly higher than overall disgust scores for internal organs ($p < .0001$ in every case). As revealed by the full MANCOVA model, overall disgust scores were inversely proportional to age, with this effect being more pronounced for interface organ disgust scores than for internal organ scores, resulting in a significant Organ-class by Age interaction, $F(1, 397) = 34.97$, $p = .000$. Women were more likely to report higher disgust scores in general, $F(1, 397) = 5.36$, $p = .015$, a pattern driven primarily by higher female disgust scores for interface organs, leading to a significant Organ-class by Sex interaction, $F(1, 397) = 10.99$, $p = .001$.

Discussion

Results from Study 2 support the prediction that interface body parts are more salient in disgust experience than internal body parts. These findings also raise several additional questions. First, Study 2 asked participants to make blanket assessments about the disgustingness of various transplantations, blurring the distinction between the two ways in which parts of the body can be salient in disgust, namely contamination sensitivity (how vulnerable is the given body part of the recipient) and contamination potency (how polluting is the given body part of the donor). While our syncretic theoretical perspective entails the prediction that both contamination sensitivity and contamination potency should be highest for those body parts that interface with the environment, it is possible that conflating these concerns in a single measure obscures patterns not consistent with this prediction. Second, previous investigations have shown that disgust sensitivity declines with age, and that women are generally more disgust sensitive than men (Curtis et al., 2004; Druschel & Sherman, 1999; Haidt et al., 1994; Quigley, Sherman, & Sherman, 1997). The interactions between organ class and, respectively, age and sex found in Study 2 suggest that it is with regard to interface body parts that individual differences in disgust sensitivity are principally manifested. In addition to bolstering our claim that interface body parts loom larger in disgust experience, this possibility allows us to address a potential reservation regarding our method. Organ and tissue transplantation is still somewhat exotic, hence sceptics might question whether our hypothetical

[2] Both bladder and intestine, though internal organs, scored within the low range of interface organs. Discussions with a focus group suggest that these organs are conceptualised as linked to the outside (food goes into the intestine, urine comes out of the bladder). Reasoning about these organs thus may recruit reactions associated with interface parts.

transplant scenario elicited genuine emotions. Examining self-reported decisions with regard to more realistic issues in the same domain, Sherman, Sherman, Smith, and Rickert-Wilbur (2001) used the Disgust Scale (D-Scale) (Haidt et al., 1994) to show that disgust sensitivity predicts attitudes toward organ donation and intention to donate after death. Accordingly, if our hypothetical scenarios elicit genuine disgust reactions, interindividual variation in those reactions should reflect variation in overall disgust sensitivity. We therefore designed a third study intended to (a) clarify the contributions of contamination sensitivity and contamination potency to participants' responses, and (b) examine the relationship between those responses and an individual's disgust sensitivity.

STUDY 3

Methods

Materials. Using the same choices, list of organs, and format, we created two versions of the instrument used in Study 2: in version 1 the scenario specifies that organs and tissues for transplantation are produced in a laboratory from one's own cells, while in version 2 the scenario specifies that these materials are taken from the bodies of people killed in accidents. Because materials from one's own body are necessarily less polluting than materials from someone else's body, and because generic cells are less polluting than a specific body part, version 1 minimises the influence of contamination potency. As a result, in version 1 evaluations of the disgustingness of a given transplantation are likely to primarily reflect the contamination sensitivity of the given body part. In contrast, version 2 maximises the salience of pollution by emphasising that: (a) another person (plausibly a stranger) is the source, and (b) that person is dead and dismembered (death and corpses are significant elicitors of disgust; see Rozin et al., 2000). Last, in order to test the association between reasoning about organ transplantation and general disgust sensitivity, the D-Scale was presented following both versions of the new instrument.

Participants. Employing the same Internet methods of recruitment and administration, 304 participants were randomly assigned to version 1 or 2. Following the criteria employed in Study 1 we discarded 72 responses, leaving a sample of 232 (118 in version 1, 114 in version 2), of which 108 were males and 124 were females. Ages ranged from 18 to 76 years (*M* 32.53, *SD* 12.99).

Results

Interface vs. internal organs. Pooling results from versions 1 and 2 and using a multivariate analysis of covariance, we replicated our previous findings. Participants reported the prospect of transplantation of internal organs (MDR = 1.24) to be significantly less disgusting than the prospect of transplantation of

interface organs (MDR = 1.82), $F(1, 227) = 139.41$, $p = .000$. Viewed independently in separate models, similar patterns obtained for both version 1: $N = 118$, Internal MDR = 1.17, Interface MDR = 1.49, $F(1, 115) = 29.12$, $p = .000$; and version 2: $N = 114$; Internal MDR = 1.31, Interface MDR = 2.16, $F(1, 111) = 116.048$, $p = .000$.

Contamination sensitivity and contamination potency. Version 2 adds contamination potency effects to the contamination sensitivity effects measured in version 1—if the prospect of replacing a given body part using relatively pure material elicits a given level of disgust, then the prospect of replacing the same body part using polluted material should increase the intensity of disgust above that baseline. In the full MANCOVA model, comparison of the results of the two versions indicates that the design was successful in this regard, as version 2 produced significantly higher overall disgust scores (MDR = 1.69) compared with version 1 (MDR = 1.32), $F(1, 227) = 49.201$, $p = .000$. Interestingly, much of this result is driven by a pattern in which interface organ disgust scores are higher in version 2 (MDR = 2.16) relative to interface organ scores in version 1 (MDR = 1.49), resulting in an Organ-class by Organ-source interaction, $F(1, 227) = 88.69$, $p = .000$; by comparison, internal organ scores in version 2 (MDR = 1.31) are more similar to internal organ scores in version 1 (MDR = 1.17) (see Figure 3). This indicates that contamination potency is more salient

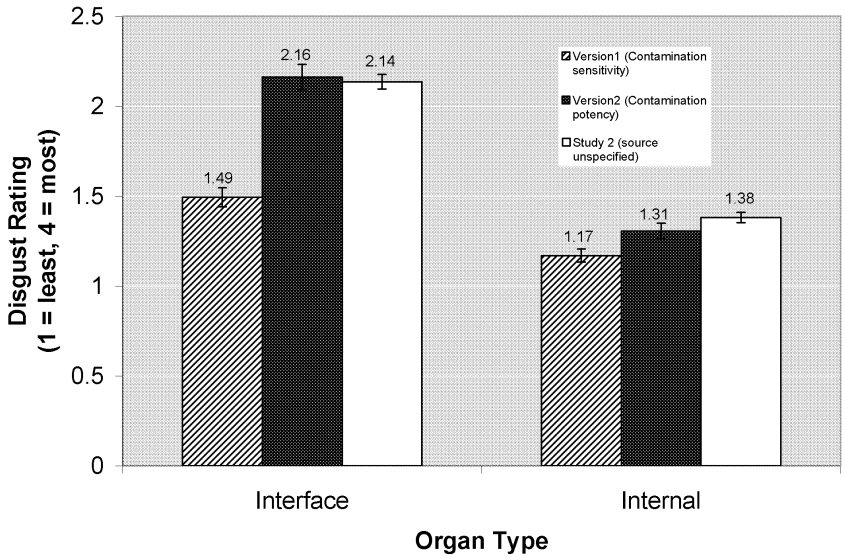

Figure 3. Study 3: Mean Disgust Rating (MDR) by organ type for version 1 and version 2 (4-point scales; with Study 2 MDRs for comparison).

for interface organs than for internal organs, a finding consistent with the premise that, from an adaptive standpoint, attention should be directed to those parts of the body that often pose a risk of pathogen transfer during social interactions.

Age and sex effects. Age and sex again influenced participants' ratings. In the full MANCOVA, pooling the two versions, transplant-disgust ratings were significantly and inversely related to subject age, $F(1, 227) = 36.91$, $p = .000$, with this effect more pronounced for interface organs than for internal organs, leading to an Organ-class by Age interaction, $F(1, 227) = 24.67$, $p = .000$. There was an overall effect of sex, $F(1, 227) = 3.97$, $p = .047$, owing primarily to an interaction between sex and organ class wherein female scores for interface organs were higher proportional to overall scores compared to male equivalents, $F(1, 227) = 13.54$, $p = .000$, again suggesting that interface organs are the most salient indices of disgust sensitivity. There were no higher-order interactions. These effects were also apparent in separate analyses conducted for each version. In separate MANCOVAs, both versions 1 and 2 showed a main effect of age: $F(1, 115) = 15.00$, $p = .000$, and $F(1, 111) = 21.67$, $p = .000$, respectively; and the same type of age by organ-class interaction: $F(1, 115) = 6.14$, $p = .015$, and $F(1, 111) = 19.022$, $p = .000$, respectively, wherein age has a greater effect on ratings of interface organs than internal organs. There were no significant main effects of sex for either version, but the sex by organ-class interaction was significant in both versions 1 and 2: $F(1, 115) = 5.82$, $p = .017$; and $F(1, 111) = 7.558$, $p = .007$, respectively.

Disgust sensitivity. Assignment to version 1 or 2 had no effect on D-Scale scores. Comparing the pooled organ transplant measures with D-Scale results (Table 1), a significant correlation emerges. Interface organ disgust scores are indeed more highly correlated with overall D-Scale scores, $r(232) = .385$, than are internal organ disgust scores, $r(232) = .252$, a difference which approaches significance ($p = .056$, Fisher's Z transformation). This pattern is consistent with the idea that body parts that interface with the environment should be most salient as foci of disgust, and hence should more sensitively reflect individual differences in disgust sensitivity. Examining demographic variables using a univariate analysis of covariance, the overall pattern of responses is similar for the D-Scale and the organ transplant scale. Scores on the D-Scale were inversely proportional to participant age, $F(1, 229) = 9.01$, $p = .003$, and females scored higher than males, $F(1, 229) = 14.47$, $p = .000$. Correspondences between scores on the organ transplant task and those on the D-Scale thus suggest that participants' responses to the former genuinely reflect disgust-based reasoning, leading us to conclude that the patterned differences between the disgust salience of interface and internal organs are unlikely to be driven by some other aspect of cognition or emotion.

TABLE 1
Study 3: Correlations among D-Scale disgust scores

	Interface	*Internal*
D-Scale disgust score		
Pearson's *r*	.385	.252
Sig. (2-tailed)	.000	.000
N	232	232
Interface		
Pearson's *r*		.675
Sig. (2-tailed)		.000
N		232

GENERAL DISCUSSION

Although phenomenological and evolutionary approaches to disgust are often seen as competing with one another, our investigations demonstrate that, at least as regards bodily disgust, the two perspectives are complementary. Phenomenologists emphasise the role of disgust as protector of the self. Our first study revealed that different parts of the body hold varying prominence in the experience of the self, differences that correspond with the extent to which body parts are sensed or perceived. In general, the parts of the body that interface with the environment are more perceived, and more intimately associated with the self, than are the inner parts of the body. Congruent with an evolutionary perspective, this pattern likely reflects an underlying neural architecture explicable in terms of the adaptive advantages of more extensive attention to and command over those parts of the body through which interaction with the environment occurs. From a phenomenological perspective, our initial findings suggest that body parts that interface with the environment should be most salient in disgust experiences, as these are most intimately related with the self. Correspondingly, an evolutionary perspective generates the same prediction, as it is at the interface with the environment that behavioural prophylaxis can shield the body from pathogens and toxins. To test this prediction we conducted two studies involving evaluations of hypothetical organ and tissue transplantation. Three key findings emerged, as follows:

First, overall, body parts that interface with the environment are more salient in disgust-related reasoning than are internal body parts, as the prospect of transplantation of the former is consistently seen as more disgusting than is the prospect of transplantation of the latter. Apertures, those portions of the interface via which materials are exchanged between the environment and the body, epitomise this pattern.

Second, individual differences in disgust sensitivity shape disgust responses to the prospect of transplantation, and these differences largely manifest themselves with regard to reasoning about the transplantation of interface parts.

Third, dissecting disgust at social contact into its constituent elements, the parts of one's own body that interface with the environment are viewed as more vulnerable to contamination via transplantation than the parts of one's body that do not; correspondingly, the parts of others' bodies that interface with the environment are viewed as more polluting via transplantation than the parts which do not.

Although the manner in which we experience our bodies is subject to both cultural influence and social feedback, such experience is probably also importantly shaped by universal features of the mind. Given that it is only within the recent past that the actual replacement of body parts has become medically feasible, there is no reason to expect natural selection to have equipped the human mind to accurately index the costs and benefits of the exchange of any given part of the body. Rather, requests to consider hypothetical organ and tissue transplants can be expected to evoke responses designed to operate in the preindustrial world of the hunter-gatherer, a world in which social contact carried a substantial risk of the transmission of pathogens and parasites. In short, operating to protect both the conceptual and the physical being, disgust is focused on the parts of the body that, under normal conditions, can touch or be touched.

Limitations of the present studies

A number of factors limit the generalisability of the findings reported here. First, the self is a complex phenomenon with many facets, only some of which are both accessible through conscious reflection and amenable to investigation using explicit measures. Accordingly, our examination of the relationship between parts of the body and the self should not be taken as exhaustive. Second, Study 1 collected two measures (perceptibility and degree of association with the self) using a within-subjects design. Although order of presentation of the measures was randomised, it is possible that the reported correlations between the measures reflect contaminating effects of co-presentation; future attempts to explore this issue should measure these factors independently.[3] Third, both within and across studies, the list of 20 body parts

[3] Study 3 also collected two measures within subjects. However, contamination effects relevant to the question at issue are unlikely given that, although there were two versions of the first measure (with corresponding between-subjects differences in responses), performance on the second measure did not differ as a function of the version of the first measure with which it was paired.

was presented in the same sequence, raising the possibility of habituation and order effects. As the list was not segregated with regard to the interface/internal dichotomy, if they occurred, such effects should not have influenced the basic patterns of our results. Nevertheless, habituation and order effects could conceivably warp responses to items that appeared late in the list. Fourth, although we interpret the greater disgust elicited by version 2 of Study 3 as due to the addition of contamination potency concerns, this pattern may be partially driven by disgust evoked by the death and dismemberment in the version 2 scenario. However, while this factor may contribute to differing overall levels of disgust in versions 1 and 2, it cannot account for the fact that this difference is largely driven by interface body parts, a key finding. Fifth, it is possible that: (a) experiences of the body are poorly accessed by a questionnaire, (b) disgust is poorly elicited by hypothetical scenarios and written tests, or (c) either set of experiences differ in important ways from those occurring in everyday life. Comparisons between written measures of disgust sensitivity and laboratory experiments reveal an incomplete correlation between the two indices (Rozin et al., 1999b), hence Studies 2 and 3 may not have fully measured the extent to which disgust is focused on various body parts. Finally, our samples likely reflect a small slice of the world's cultures. The manner in which participants were recruited makes it likely that the majority either primarily identified with, or were intimately familiar with, the dominant cultures of the English-speaking West. Moreover, given that Internet use is not ubiquitous in these cultures, nor is interest in participation in psychological research, our self-selected samples are unlikely to be representative of the larger societies from which they were drawn. It is plausible that, in addition to the factors that we have postulated here, the association between various body parts and the self, and the degree of disgust associated with transplantation of various body parts, is in part determined by cultural models concerning the meaning and functioning of those parts. Research involving representative samples from diverse cultures is therefore in order.[4]

In the light of the above limitations, our investigations of the relationship between the body, the self, and disgust should be considered preliminary. However, if the interface/noninterface distinction found in our studies indeed reflects a facet of human psychology shaped by natural selection, then the same

[4] Despite a cultural model of the heart as the seat of emotions, participants in Studies 2 and 3 treated the heart as essentially similar to other internal organs. In contrast, Sanner (2001a, 2001b) reports that Swedish respondents differentiated between the heart and ''more anonymous organs'', and Sharp (1995) makes similar observations for the US; Belk and Austin's US respondents rated the heart highly on a scale of ''selfness''. Our participants' lack of attention to the heart may be due to the frequency of heart transplants, a factor that could normalise the procedure. Alternately, our request for disgust ratings may have elicited only the most elementary type of disgust reaction, one not mediated by symbolic meanings.

basic dichotomy should appear in studies conducted using samples drawn from widely disparate cultural backgrounds.

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