

Things Rank and Gross in Nature: A Review and Synthesis of Moral Disgust

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Much like unpalatable foods, filthy restrooms, and bloody wounds, moral transgressions are often described as “disgusting.” This linguistic similarity suggests that there is a link between moral disgust and more rudimentary forms of disgust associated with toxicity and disease. Critics have argued, however, that such references are purely metaphorical, or that moral disgust may be limited to transgressions that remind us of more basic disgust stimuli. Here we review the evidence that moral transgressions do genuinely evoke disgust, even when they do not reference physical disgust stimuli such as unusual sexual behaviors or the violation of purity norms. Moral transgressions presented verbally or visually and those presented as social transactions reliably elicit disgust, as assessed by implicit measures, explicit self-report, and facial behavior. Evoking physical disgust experimentally renders moral judgments more severe, and physical cleansing renders them more permissive or more stringent, depending on the object of the cleansing. Last, individual differences in the tendency to experience disgust toward physical stimuli are associated with variation in moral judgments and morally relevant sociopolitical attitudes. Taken together, these findings converge to support the conclusion that moral transgressions can in fact elicit disgust, suggesting that moral cognition may draw upon a primitive rejection response. We highlight a number of outstanding issues and conclude by describing 3 models of moral disgust, each of which aims to provide an account of the relationship between moral and physical disgust.

Keywords: disgust, morality, emotion, judgment

In Shakespeare’s great tragedy *Hamlet*, the protagonist is faced with intolerable injustice: Prince Hamlet’s uncle Claudius has murdered Hamlet’s father, the rightful king, then usurped the throne and married Hamlet’s mother. Hamlet likens this state of affairs to an unweeded garden possessed completely by “things rank and gross in nature.” Four hundred years later, a rapidly developing line of research suggests that such references to the unsavory or distasteful nature of unjust behavior may not be confined to the realm of metaphor; rather, they may reflect a biological reality. Our aim in this review is to evaluate recent studies that have examined the role of disgust in morality. We argue that although individual studies of moral disgust may have limitations, they converge to support a specific role for disgust in moral cognition. We also consider a number of outstanding questions and close by discussing several alternative models of moral disgust.

Disgust: Origins and Expansion

At first glance, disgust may seem to be an unlikely candidate for a moral emotion. Disgust is thought to have originated in distaste,

a food-rejection impulse or motivation triggered by the ingestion of unpleasant-tasting substances, prototypically those that are bitter (Chapman, Kim, Susskind, & Anderson, 2009; Rozin & Fallon, 1987). Because many bitter substances are toxic (Garcia, Hankins, Denton, & Coghlan, 1975), the role of distaste in food rejection has a clear and concrete adaptive function. Distaste appears to have very ancient origins: Even sea anemones, which first evolved some 500 million years ago, will expel bitter foods from their gastric cavity (Garcia et al., 1975). Distaste also appears very early in human ontogeny: Infants only a few hours old produce a characteristic facial grimace in response to bitter tastes (Steiner, 1973), implying that the distaste response may be innate in human beings.

The distaste system is thought to be the foundation for food-related disgust, the most basic form of disgust proper (Rozin & Fallon, 1987). Disgust differs from distaste in being less closely tied to sensory properties of the stimulus: for example, you do not need to taste a cockroach to be disgusted by it (Rozin & Fallon, 1987). Disgusting objects also evoke a stronger subjective feeling of offense and are more contaminating than distasteful objects (Rozin & Fallon, 1987; Rozin, Markwith, & McCauley, 1994). Although individuals might simply eat around a bitter vegetable on their plate, they are unlikely to do the same if someone spits in their dinner.

With its basic properties established, the core rejection impulse of disgust may then have expanded into other threat domains, through the accretion of new stimulus triggers (Rozin & Fallon, 1987). These include body products (e.g., feces, blood), certain sexual practices (e.g., incest, bestiality), violations of the outer body envelope (e.g., injuries), and diseased or unhygienic individ-

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uals (Curtis & Biran, 2001; Rozin, Haidt, & McCauley, 2000). Collectively, we refer to disgust triggered by this assortment of rather concrete stimuli as *physical disgust*.

There is now considerable evidence that physical disgust serves a disease-avoidance function (Curtis, Aunger, & Rabie, 2004; Curtis & Biran, 2001; Oaten, Stevenson, & Case, 2009). For example, many physical disgust stimuli are potential carriers of disease (e.g., body products, decaying organic matter; Curtis & Biran, 2001) or have other consequences associated with reduced biological fitness (e.g., incest; Fessler & Navarrete, 2004; Westermarck, 1891). The ability of disgusting objects to contaminate neutral objects is consistent with the transmissibility of pathogens through physical contact (Pinker, 1997). Moreover, the behavioral, experiential, and physiological correlates of disgust are all compatible with a role in disease avoidance. The prototypical disgust expression is characterized by a wrinkled nose, raised upper lip, and narrowed eyes (Ekman & Friesen, 1975b, 1978). These actions are associated with a decrease in the exposed area of the eyes and closure of the nasal cavities, which may serve to protect the vulnerable mucous membranes of the face from exposure to infection (Susskind et al., 2008). The subjective experience of disgust is one of revulsion and offense, often coupled with a behavioral tendency to withdraw from the disgusting stimulus or to remove the stimulus from the self (e.g., by washing, spitting; Rozin, Haidt, & McCauley, 1999).

Physiologically, disgust appears to be related to activation of the parasympathetic nervous system (PNS; Ekman, Levenson, & Friesen, 1983; Levenson, Ekman, & Friesen, 1990). Although this may appear paradoxical, given that PNS dominance is usually linked with “resting and digesting,” increased salivation associated with PNS activity may serve to flush contaminants from the mouth and more generally may reflect the origin of disgust in gating ingestion. Along these lines, disgust is prominently associated with nausea and vomiting, although these responses can be caused by other emotional states such as anxiety (Rozin et al., 2000). Nausea may serve as a signal not to eat toxic or contaminated food (Stern, 2002), and if such preventative signals fail, vomiting can help to rid the body of the harmful ingestant. The association between disgust and vomiting may also shed light on the connection between disgust and PNS activity: Many antiemetic drugs decrease activation of the PNS (Parker & Limebeer, 2006). Moreover, increased salivation, related to PNS activity, may serve to protect tooth enamel and oral tissues from being damaged by stomach acid during vomiting (Ogren, Huerter, Pearson, Antonson, & Moore, 1987).

In sum, the behavioral and physiological features of disgust are consistent with an origin in disease avoidance and may complement the disgust facial expression in facilitating the avoidance or rejection of disgusting stimuli. There is, however, one notable exception to the association between disgusting stimuli and disease. Specifically, the violation of social and moral norms also appears to elicit disgust (Rozin et al., 2000). For example, theft, lying, and fraud all elicit reliable self-reports of disgust (Tybur, Lieberman, & Griskevicius, 2009). We refer to disgust elicited by abstract sociomoral transgressions as *moral disgust*. If the triggers for disgust have indeed expanded out of the physical world and into the social realm, this shift would represent a compelling example of exaptation (also known as preadaptation; Rozin et al., 2000), an evolutionary process whereby a preexisting structure

assumes a new functional role without changing its basic form (Bock, 1959; Mayr & Tax, 1960). The involvement of disgust in morality would also have important consequences for our view of moral cognition. In particular, it would provide strong support for the idea that the human moral sense draws upon evolutionarily ancient precursors, at least to some extent, rather than relying exclusively on more recently evolved higher cognitive functions (Greene & Haidt, 2002; Haidt, 2007).

The status of disgust as a moral emotion has not gone unchallenged, however. In particular, some have argued that disgust is elicited only by moral transgressions that contain physical disgust stimuli (e.g., gory murders, sexual crimes; Bloom, 2004; Oaten et al., 2009; Rozman & Sabini, 2001; Rozin, Lowery, Imada, & Haidt, 1999) and that other references moral disgust are purely metaphorical. Our goal in the current review is to evaluate these competing views of moral disgust. To this aim, we searched PubMed and PsycINFO in the winter of 2012 for journal articles referring to both “disgust” and “moral.” Tables 1, 2, and 3 summarize the articles that were selected for primary consideration.

We chose to limit our survey to articles that focused on proscriptive morality, which is concerned with what one should *not* do (Janoff-Bulman, Sheikh, & Hepp, 2009). A few studies have begun to examine the influence of disgust on prescriptive morality; that is, what one *should* do (e.g., prosocial behavior such as helping and charity; Horberg, Oveis, Keltner, & Cohen, 2009; Liljenquist, Zhong, & Galinsky, 2010; Zhong & Liljenquist, 2006). However, this literature remains very small, particularly compared to what is known about disgust and proscriptive morality.

We begin our review by asking whether there is evidence that moral transgressions evoke signs of disgust, be they neurophysiological, experiential, expressive, or behavioral. To examine the causal role of disgust, we then pose the reverse question: Does inducing disgust have an impact on moral judgments? Last, we ask whether individual differences in the tendency to experience physical disgust are associated with variation in moral cognitive processes. We argue that the answer to each of these questions is yes. Taken together, these studies provide converging empirical support for the expansion of disgust into the social and moral realm.

A Note on Terminology and Directionality

Before we begin our discussion of disgust and morality, a few issues warrant preliminary consideration. First, what we mean by “morality”; second, the nature and direction of the relationship between emotion and moral judgment; and third, what we mean by “moral cognition.”

Although the field of moral psychology is expanding rapidly, there is as yet no consensus as to how morality should be defined. The dominant approaches at present appear to be moral domain theory, arising from a long research tradition in developmental psychology (Turiel, Killen, & Helwig, 1987); the “big three” model, derived from anthropological observations (Shweder et al., 1997); and five foundations theory, a relative newcomer that has quickly gained considerable influence (Graham, Haidt, & Nosek, 2009). A review of these different models is beyond the scope of this article, and readers are directed to the accompanying references for further information. We especially encourage interested readers to familiarize themselves with moral domain theory (Turiel

Table 1
Summary of Experiments That Manipulate Morality and Measure Disgust

Study	Sample size	Moral IV	Disgust DV	Results	Caveats
Functional neuroimaging studies					
Moll et al. (2005)	13	Written mixed transgressions	fMRI activity	+	No pure moral transgressions No other comparison IV
Parkinson et al. (2011)	38	Written pure and mixed transgressions	fMRI activity	+	No pure physical disgust condition No other comparison IV
Schaich Borg et al. (2008)	50	Written pure and mixed transgressions	fMRI activity	+	No other comparison IV
Behavioral studies: Self-report measures					
Chapman et al. (2009)	16	Unfair economic game	Rate disgust expression: Continuous	+	
Danovitch & Bloom (2009)	60	Written pure transgressions	Verbal disgust report: Forced choice	+	Many participants did not report disgust toward any transgressions
	52	Written pure transgressions	Rate disgust expression: Forced choice	+	No other comparison DV Many participants did not report disgust toward any transgressions
Gutierrez et al. (2012)	80	Written pure and mixed transgressions	Verbal disgust report: Continuous	+	
			Rate disgust expression: Continuous	+	
			Forced choice	-	Forced-choice procedure
Horberg et al. (2009)	96	Written pure and mixed transgressions	Verbal disgust report: Continuous	-	Self-report includes physical disgust descriptors Very minor pure transgressions
Hutcherson & Gross (2011)	151	Written pure and mixed transgressions	Verbal disgust report: Continuous	+	
			Forced choice	+	
Rozin, Lowery, et al. (1999)	191	Written pure and mixed transgressions	Verbal disgust report: Forced choice	-	Forced-choice procedure
			Rate disgust expression: Forced choice	-	Forced-choice procedure Nonstandard emotional expressions
Simpson et al. (2006)	42	Photographs of pure transgressions	Verbal disgust report: Continuous	+	
Young & Saxe (2011)	160	Written pure and mixed transgressions	Verbal disgust report: Continuous	+	
Behavioral studies: Implicit and expressive measures					
Cannon et al. (2011)	39	Written pure and mixed transgressions	Disgust expression production	+	
Chapman et al. (2009)	16	Unfair economic game	Disgust expression production	+	
Jones & Fitness (2008)	40	Written pure transgressions	Complete disgust/cleaning word stems	+	Results could be nonspecific to disgust
			Choose cleaning product	+	Results could be nonspecific to disgust
Rozin, Lowery, et al. (1999)	193	Written pure and mixed transgressions	Disgust expression production	-	Unusual measure of disgust expression
Zhong & Liljenquist (2006)	60	Recall of personal transgressions	Complete cleaning word stems	+	Results could be nonspecific to disgust
	32	Recall of personal transgressions	Choose cleaning product	+	Results could be nonspecific to disgust
Miscellaneous studies					
Nabi (2002)	140	Recall disgusting events	Essay theme: Physical or moral	+	

Table 1 (continued)

Study	Sample size	Moral IV	Disgust DV	Results	Caveats
Taylor (2007)	NA	Hate texts	Number of disgust references	+	Some results could be nonspecific to disgust

Note. Moral IV (independent variable) column: A pure transgression is one that does not reference physical disgust; a mixed transgression is one that incorporates both physical disgust and a moral transgression. Disgust DV (dependent variable) column: A forced-choice procedure is a self-report in which participants must choose a single emotion descriptor. A continuous self-report uses a Likert-type scale. Results can differ between the two procedures. Results column: A plus sign indicates that the results support the notion that pure moral transgressions elicit disgust; a minus sign indicates that the results suggest only mixed moral transgressions elicit disgust. Caveats column: Indicates any concerns with either methods or results. "No other comparison DV" means that only disgust was measured, so the specificity of the moral manipulation to disgust is unclear. "No other comparison IV" is primarily a concern for neuroimaging studies; it means that only physical disgust and morality were manipulated, so the specificity of any neural overlap between disgust and morality cannot be established. Forced-choice procedures may explain negative results, as they may be biased against moral disgust when a transgression elicits more than one emotion. Self-report measures that include terms slanted toward physical disgust (e.g., *grossed out, revulsion*; Nabi, 2002) may also be biased against moral disgust. See text for details. fMRI = functional magnetic resonance imaging; NA = not applicable.

et al., 1987), which is little referenced outside of the developmental community.

In any case, such a review would only serve to highlight that these theories define morality differently. Moreover, empirical studies in the area often do not specify what—if any—model they adhere to, relying instead on a quick-and-dirty operationalization

of "anything that participants consider to be wrong." The problem with this ad hoc approach is that some theories of morality maintain that not everything that is judged to be wrong is necessarily immoral (Turiel et al., 1987). Even theories that place more emphasis on naive or folk psychological views of morality propose that there are meaningful subcategories within the broader realm of

Table 2

Summary of Experiments That Manipulate Disgust and Measure Morality

Study	Sample size	Disgust IV	Moral DV	Results	Caveats
David & Olatunji (2011)	61	Physical disgust conditioned with photographs	Judge pure and mixed transgressions	0	Photographs depict injuries rather than contamination
Eskine et al. (2011)	57	Drink bitter liquids	Judge pure transgressions	+	
Harlé & Sanfey (2010)	179	View physical disgust films	Accept/reject economic game offers	+	Serenity films also associated with increased offer acceptance
Helzer & Pizarro (2011)	52	Cleanse hands	Judge pure and mixed transgressions	–	No other comparison IV Some pure transgressions very minor
Horberg et al. (2009)	122	View physical disgust films	Judge pure and mixed transgressions	–	Pure transgressions presented may be less affected by incidental disgust
Moretti & di Pellegrino (2010)	45	View physical disgust photographs	Accept/reject economic game offers	+	
Schnall, Benton, & Harvey (2008)	40	Unscramble cleaning-related words	Judge pure and mixed transgressions	+	No other comparison IV
	44	Cleanse hands	Judge pure and mixed transgressions	+	No other comparison IV
Schnall, Haidt, et al. (2008)	127	Exposure to flatus spray	Judge pure and mixed transgressions	+	No other comparison IV
	43	Exposure to dirty environment	Judge pure and mixed transgressions	+	No other comparison IV
	69	Recall physical disgust events	Judge pure and mixed transgressions	+	No other comparison IV
	133	View physical disgust films	Judge pure and mixed transgressions	+	
Ugazio et al. (2012)	286	Exposure to flatus spray, physical disgust films	Judge pure and mixed transgressions	+	
Wheatley & Haidt (2005)	64	Posthypnotic suggestion of disgust	Judge pure transgressions	+	No other comparison IV
Zhong et al. (2010)	58	Cleanse hands	Judge social issues	+	No other comparison IV
	323	Imagine clean or dirty self	Judge social issues	+	No other comparison IV

Note. Disgust IV (independent variable) column: Method used to induce disgust. Moral DV (dependent variable) column: A pure transgression is one that does not reference physical disgust; a mixed transgression is one that incorporates both physical disgust and a moral transgression. Results column: A plus sign indicates that pure moral transgressions were affected by the disgust/cleanliness manipulation; zero indicates that pure moral transgressions were not affected by the manipulation; a minus sign indicates that only mixed transgressions were affected by the manipulation. Caveats column: Gives any concerns with either methods or results. "No other comparison IV" indicates that only disgust was manipulated as an independent variable, so the specificity of any manipulation effects to disgust cannot be determined. See text for details.

Table 3
Summary of Individual Differences Studies

Study	Sample size	Primary individual differences construct	Moral task or construct	Results	Caveats
Hodson & Costello (2007)	103	Trait physical disgust	Evaluate outgroups	+	Specificity to trait physical disgust unclear
Horberg et al. (2009)	86	Trait physical disgust	Judge pure and mixed transgressions	-	Very minor pure transgressions Unvalidated trait disgust measure
Inbar, Pizarro, & Bloom (2009)	181	Trait physical disgust	Social conservatism	+	Specificity to trait physical disgust unclear
	91	Trait physical disgust	Judge pure and mixed social issues	-	Selected pure social issues may be less related to trait physical disgust Specificity to trait physical disgust unclear
Jones & Fitness (2008)	72	Trait physical disgust	Judge pure transgressions	+	
	53	Trait physical disgust	Judge pure transgressions	+	
Olatunji, Abramowitz, et al. (2007)	352	OCD concerns	Trait pure moral concerns	+	Nonclinical sample
Olatunji et al. (2005)	100	Trait physical disgust	Trait pure moral concerns	+	Specificity to trait physical disgust unclear
Tybur et al. (2009)	2,086	Trait physical disgust	Trait disgust toward pure transgressions	+	

Note. Moral task or construct column: A pure transgression, social issue, or concern is one that does not reference physical disgust; a mixed transgression is one that incorporates both physical disgust and a moral transgression. Results column: A plus sign indicates that variation in the primary individual differences construct was related to variation in scores on the pure moral task or construct; a minus sign indicates that the primary individual differences construct was related only to variation in mixed transgressions or constructs. Caveats column: Gives any concerns with either methods or results. "Specificity to trait physical disgust unclear" indicates a concern that individual differences other than trait physical disgust could explain the results. Of particular concern are differences in other trait emotions such as anger or anxiety. OCD = obsessive-compulsive disorder.

morality, such as justice, tradition, or loyalty (Graham et al., 2009).

There is no easy solution to this problem, and in the current review we take a pragmatic approach by simply providing examples of the kinds of "moral" stimuli used in each study. Although we highlight some cases where discrepant results among studies could be due to differing definitions of morality, the literature in this area is unfortunately not yet large enough to permit much direct comparison.

A second issue that bears some preliminary consideration is the direction of the relationship between moral emotion and moral judgment. To clarify, we consider moral judgments to be assessments of moral value, such as right or wrong, good or bad. We consider moral emotions to be any emotion associated with a moral event. What is important to note here is that we do not assume that moral judgments and moral emotions are the same thing or that moral emotions necessarily explain all of the important variance in moral judgments.

A final point of clarification is that we use the term *moral cognition* in the most general sense, to refer to any processing associated with moral transgressions. This may include both "affective" and "cognitive" processes, although we do not subscribe to the view that there is a sharp boundary between the two.

Are Moral Transgressions Disgusting? Manipulating Morality, Measuring Disgust

With these preliminaries covered, we now return to our primary topic, the relationship between disgust and morality. A straight-

forward place to begin is by asking whether individuals who are exposed to moral transgressions experience disgust. That is, are moral transgressions disgusting? Note that we are not concerned with whether disgust is the only emotion evoked by moral transgressions; this seems trivially unlikely. Nor is it particularly important that disgust should always be the strongest emotion triggered by immorality. Rather, the null hypothesis of interest is that moral transgressions should elicit little or no disgust. After all, why should an emotion rooted in disease avoidance be triggered by a moral transgression? What *is* important is that any dependent measures used to index disgust should be able to distinguish between disgust and other emotions. We return to this issue frequently below.

A key question in the following sections will be whether disgust is reserved for moral transgressions that contain reminders of physical disgust; that is, those that violate moral codes related to purity or divinity, which forbid behavior that is polluting, filthy, inhuman, or profane (Graham et al., 2009; Horberg et al., 2009; Rozin, Lowery, et al., 1999). Examples of purity violations from the literature include engaging in consensual incest, receiving a blood transfusion from a child molester, and eating rotten meat. It is not surprising that people find such scenarios to be disgusting, given that they describe classic physical disgust stimuli. However, because physical disgust and immorality are confounded, it is not clear whether any of this disgust can be attributed to the immoral nature of the actions described. In what follows, we are more interested in whether transgressions that do not reference physical disgust stimuli can elicit signs of disgust experience. We refer to such transgressions as "pure" transgression stimuli.

Functional Neuroimaging Studies

Because neuroimaging studies of morality and emotion have received considerable attention in recent years, we first consider whether individuals who are exposed to moral transgressions show neural activity that is consistent with the experience of disgust. The anterior insula is often suggested as a neural marker of disgust (for a review, see Chapman & Anderson, 2012), and indeed, this region is frequently activated when participants view disgusting photographs (e.g., Schienle, Schafer, Stark, Walter, & Vaitl, 2005; Schienle et al., 2002; Wright, He, Shapira, Goodman, & Liu, 2004), disgusting videos (Harrison, Gray, Gianaros, & Critchley, 2010), or disgusted facial expressions (Jabbi, Bastiaansen, & Keysers, 2008; Phillips et al., 1997). Moreover, evidence from non-human primates as well as human neuroimaging studies suggests that the insula contains both primary and secondary gustatory cortex (Small et al., 1999). Given the alleged origin of disgust in food rejection, co-localization of disgust with gustatory cortex makes sense. There is also some indication that the insula may subserve more abstract, social forms of disgust: for example, extreme social outgroups that elicit self-reports of disgust also evoke activation of the insula (Harris & Fiske, 2006).

This evidence linking disgust to the insula might lead one to reason that if a study found insular activation in response to moral transgressions, one could infer that participants experienced disgust in response to the transgressions. Unfortunately for this logic, the insula is activated by a host of other affective and cognitive processes, including anger (Damasio et al., 2000), anxiety (Critchley, Wiens, Rotshtein, Ohman, & Dolan, 2004), pain (Peyron, Laurent, & Garcia-Larrea, 2000), general visceral awareness (Critchley et al., 2004), uncertainty (Grinband, Hirsch, & Ferrera, 2006), integrating exteroceptive with interoceptive stimulation (Farb, Segal, & Anderson, 2012), and perceptual decision making (Binder, Liebenthal, Possing, Medler, & Ward, 2004; for a review, see Craig, 2009). In short, inferring disgust from insular activation is a rather questionable reverse inference (Poldrack, 2006). The insula is also a large brain region, consisting of five to seven gyri with considerable morphological variation among individuals (Craig, 2009). Comparison across studies with different samples (e.g., one in which physical disgust was investigated and one in which morality was investigated) is thus particularly suspect, as there is no guarantee that the same insular region was activated in both studies.

A more promising approach is to investigate the neural correlates of both physical disgust and moral cognition in the same participants. Under these conditions, common activation in response to both types of stimuli would allow for a stronger inference of shared processing, although as described, we cannot be certain that any shared processing necessarily represents disgust. To date, three studies have examined the neural correlates of both physical disgust and moral cognition (see Table 1; Moll et al., 2005; Parkinson et al., 2011; Schaich Borg, Lieberman, & Kiehl, 2008). In the earliest study (Moll et al., 2005), participants passively read sentences describing physical disgust situations (e.g., seeing a cat eating feces), situations designed to evoke feelings of indignation (e.g., putting a spider on a baby's face), and neutral acts (e.g., going to a museum). Indignation was considered to be a moral emotion, and accordingly the indignation condition was hypothesized to tap morality.

The physical disgust and indignation scenarios commonly activated frontal regions including medial and lateral orbitofrontal cortex (OFC; typically thought to be associated with emotional processing; Anderson et al., 2003; Bechara, Damasio, & Damasio, 2000; Rolls, 2004; Small et al., 2003), as well as bilateral superior and left inferior frontal gyri and inferior temporal gyrus. There were also differences between the physical disgust and indignation conditions. Physical disgust relative to indignation was associated with greater activation of the right anterior cingulate and inferior frontal gyrus, as well as greater amygdala activation (at a more lenient significance threshold). Indignation relative to physical disgust elicited greater activation of more anterior sectors of OFC, anterior superior frontal gyrus, and right anterior temporal gyrus.

The overlap that was observed in regions associated with emotional evaluations could suggest that indignation and physical disgust activate similar emotional processes. However, caution is warranted because some of the examples given for indignation stimuli contained reminders of physical disgust (e.g., seeing a cockroach in a restaurant). This raises the possibility that the overlapping activation could have been related to physical disgust reminders in the indignation stimuli, rather than to the immoral nature of the actions described. As well, since no other emotional comparison condition was included, it is not clear whether the overlap reflects shared processing with disgust *per se* or more generic emotional processes such as general negative affect or arousal. Last, this study did not find overlap in the insular regions that putatively support physical disgust. However, the physical disgust condition alone also did not trigger insular activation, so this null result is difficult to interpret.

The second study (Schaich Borg et al., 2008) also used sentences as stimuli, with separate conditions designed to tap pathogen-related disgust (e.g., drinking urine), incest-related disgust (e.g., sexual acts with a sibling), and moral transgressions (e.g., murder, theft), with neutral actions for comparison. The sample moral transgressions that were provided did not contain direct references to physical disgust stimuli, and although it is possible that sentences describing physical harm or death could evoke thoughts of blood or injuries, this seems unlikely given the direct and factual tone of the scenarios. Indeed, subjective ratings collected after the scan showed that the moral stimuli evoked less disgust than the incest and pathogen stimuli (although still more than neutral). Moral wrongness ratings were also collected, revealing that the incest and moral stimuli were judged to be equally wrong. As such, incest may have features of both physical disgust, in that it is associated with reduced long-term fitness, and morality, in that it is viewed as wrong.

During the fMRI scan, participants were asked to memorize the sentences, with a new/old recognition test later in each block. An analysis that examined common activation for the pathogen, incest, and moral conditions found large regions of overlap, including frontal areas similar to those observed in the Moll et al. (2005) study, as well as amygdala, anterior cingulate, basal ganglia, and temporal regions. However, because no other emotion condition was included for comparison, we cannot determine the extent to which this overlap is specific to disgust-related processing. Also as in the Moll et al. study, no overlap was observed in the anterior insula; however, insular activation was not observed for the pathogen stimuli relative to the moral or the incest stimuli either, so the null finding is once again difficult to interpret.

Turning to differences between conditions, the two stimulus types that received high moral wrongness ratings (i.e., moral transgressions and incest) were associated with greater activation relative to the pathogen condition in several brain regions that are often activated by social cognition, including posterior superior temporal sulcus, precuneus, and dorsal medial prefrontal cortex (Mitchell, 2009). This may imply a higher burden of social cognitive processing for stimuli that are viewed as morally wrong, relative to physical disgust stimuli. Moral transgressions alone did not evoke any additional activation relative to pathogens or incest, although this could simply be because the pathogen and incest stimuli were more emotionally arousing than the moral stimuli. Pathogen stimuli relative to moral transgressions and incest also evoked activation in the OFC, left inferior frontal gyrus, and precuneus, among other regions.

The third and most recent study (Parkinson et al., 2011) again used sentence stimuli, this time asking participants to judge whether the main character's actions were wrong or not. Four types of scenarios were presented: harm scenarios, in which one individual physically harms another; dishonesty scenarios, in which one person deceives another; sexual scenarios describing necrophilia, incest, and other unusual sexual practices; and neutral scenarios describing everyday events. The sexual stimuli, but not the other categories,¹ were also rated as disgusting and can thus be considered to tap physical disgust as well as morality. The sexual stimuli were also judged to be more emotionally arousing than the other categories.

Neuroimaging analyses indicated that only one brain region, an area of dorsomedial prefrontal cortex, was commonly activated by all three moral conditions, including the disgusting sexual stimuli, relative to neutral. Similar activation was seen in the two earlier fMRI studies. However, because the physically disgusting sexual stimuli were also viewed as immoral, it is not clear whether this shared activation represents shared emotions (e.g., disgust) or shared social/moral processing (e.g., thinking about people; Mitchell, 2009).

Unlike the previous two studies, Parkinson et al. (2011) did find increased activation of the anterior insula for the physically disgusting sexual scenarios relative to neutral and also relative to the harmful and dishonest conditions. By contrast, the harmful and dishonest conditions did not result in insular activation relative to neutral. On the one hand, these results could be taken as evidence that purely moral offenses do not activate the anterior insula circuitry that putatively supports physical disgust. On the other hand, subjective ratings indicated that the sexual scenarios were more emotionally arousing than the harmful or dishonest scenarios. As such, it is possible that more arousing moral transgressions could result in insular activation.

Consistent with this idea is a study that presented very difficult and emotional moral dilemmas, such as whether to kill a crying baby to save an entire village from enemy soldiers, as well as transgressions that did not involve conflicting moral imperatives, such as a mother considering whether to kill her unwanted infant (Greene, Nystrom, Engell, Darley, & Cohen, 2004). Relative to the low-conflict transgressions, the strongly emotional high-conflict dilemmas resulted in heightened activation of the anterior insula. The ambiguity surrounding insular activation for moral transgressions highlights the importance of careful matching across stimulus categories in fMRI studies. Until an experiment is conducted in

which emotional arousal is controlled across physical disgust stimuli and moral transgressions, the insula's involvement in morality and its potential relationship to disgust remain unclear.

In summary, the three fMRI studies that have been conducted to date show that physical disgust stimuli and pure moral transgressions have at least some common neural substrates, including regions associated with emotional evaluations, but also significant differences. However, each study is subject to limitations that restrict interpretability, as far as the moral affiliations of disgust are concerned. Future studies could avoid these difficulties by (a) ensuring that the moral stimuli that are used do not include references to physical disgust; (b) carefully controlling for differences between physical disgust and moral stimuli on variables such as emotional arousal; and (c) including another emotional condition for comparison (e.g., sadness, fear). At present, the existing neuroimaging studies do not provide unequivocal evidence that moral transgressions can evoke disgust.

Behavioral Studies

Given the difficulties with interpreting existing neuroimaging data, we now consider more traditional behavioral studies. In the following sections, we consider studies that have employed the most direct behavioral approach: manipulating the moral content of a stimulus and then measuring whether disgust ensues.

As mentioned, we are primarily interested in the null hypothesis that "pure" moral transgressions—those that do not reference physical disgust stimuli—will evoke little or no disgust. Because of this, we require data on absolute levels of disgust, and studies that report only standardized data are not helpful, particularly when no neutral control condition is included (e.g., Gutierrez & Giner-Sorolla, 2007; Russell & Giner-Sorolla, 2011). For example, standardized data could indicate that pure transgressions elicit less disgust than transgressions containing a physical disgust reminder, but this would not tell us whether pure transgressions elicit greater-than-zero levels of disgust.

Self-report measures of disgust. Among the studies that do report some kind of absolute measure of disgust, the simplest experimental design has been to present a transgression and then collect ratings or self-reports of disgust (see Table 1). Several studies of this type appear to suggest—at least at first glance—that disgust may actually be confined to transgressions that contain physical disgust reminders. In pioneering research, Rozin, Lowery, et al. (1999) presented written scenarios describing three types of moral transgressions related to Shweder's "big three" moral codes (Shweder et al., 1997): community violations, in which an individual fails to carry out his or her duty within a community or hierarchy (e.g., a teenager eating dinner before everyone else is served); autonomy violations, in which an individual harms an-

¹ Although only the sexual scenarios were judged to be disgusting, a forced-choice self-report method was employed, which may be biased against detecting disgust toward pure moral transgressions; see the section on self-report measures of disgust below for details. Instructions for the disgust question also specifically indicated that participants were *not* being asked "... whether it [the act] is morally horrendous" but rather whether "the act is disgusting in the way that most people find it disgusting to lick toilets or have oral sex with their grandparents." Participants might have interpreted these instructions to mean that they should ignore any disgust felt toward nonsexual moral transgressions.

other or infringes on the other's rights (e.g., a husband who abuses his wife); and divinity violations, in which an individual disrespects the sacredness of god or behaves in an impure manner (e.g., eating rotten meat). The community and autonomy violations do not reference physical disgust, whereas the divinity violations clearly do.

Participants were asked to indicate whether a person in each situation would predominantly feel disgust, anger, or contempt in response to the action described. A large proportion of participants (46–79%) associated disgust with the divinity violations, which is not surprising given that these scenarios described physical disgust stimuli. However, only a small minority (9–18%) reported that disgust was appropriate for the transgressions that did not involve physical disgust stimuli (i.e., the community and autonomy violations). Instead, anger and contempt were the dominant responses to autonomy and community violations, respectively.

Similarly, a recent study by Horberg et al. (2009) presented participants with two purity violations (consensual incest; having sex with and then eating a dead chicken) and two justice violations (not returning an important library book; interrupting meetings to ask for small favors). Participants rated the scenarios using three disgust terms (“disgusted,” “grossed out,” “queasy, sick to my stomach”) and three anger terms (“angry,” “mad,” “furious”). A composite score was computed for each emotion. Although the purity violations received relatively high composite disgust ratings, the justice violations received composite disgust ratings close to the bottom of the scale. Conversely, participants reported more composite anger to the justice violations and less to the purity violations.

The small number of items in this study is of concern, and we have doubts as to whether the two justice violations that were used adequately sample the moral domain (e.g., is interrupting a meeting wrong in the same way as committing a murder?). Nonetheless, combined with those of the Rozin, Lowery, et al. (1999) study, the results seem inconsistent with the possibility of disgust toward pure moral transgressions. However, the format of the self-report questions in these two studies might be biased against moral disgust. Previous work has shown that asking participants to recall a time that they felt “disgust” or “disgusted” elicits reports of both social and nonsocial (i.e., physical disgust) events (Nabi, 2002). On the other hand, “grossed out” and “revulsion” elicit mostly memories of physical disgust stimuli (Nabi, 2002). Horberg et al. (2009) used a composite measure consisting of “disgust” plus two descriptors that may tap physical disgust more closely (“grossed out” and “queasy”). If the latter terms are insensitive to moral disgust (Hutcherson & Gross, 2011; Nabi, 2002), this approach may underestimate disgust in response to moral transgressions.

Another factor that may cause moral disgust to be underestimated is the use of a forced-choice procedure, as in the study by Rozin, Lowery, et al. (1999). Forced-choice response formats encourage participants to treat the options as mutually exclusive and may be particularly inappropriate in cases where more than one emotion is elicited (Russell, 1994). If pure moral transgressions elicit nonzero levels of both anger and disgust, but levels of anger are somewhat greater, a forced-choice format may be insensitive to the disgust component of the response.

Consistent with the idea that past work may have underestimated moral disgust is a recent study that used the same stimuli as

Rozin, Lowery, et al. (1999) but changed the self-report format (Hutcherson & Gross, 2011). Participants were asked to report on their feelings of “moral disgust,” “grossed out,” anger, contempt, sadness, and fear/anxiety, using a Likert-type scale. Unlike the previous two studies, this method revealed substantial disgust toward autonomy and community violations. Ratings of moral disgust for the community and autonomy violations were close to or above the midpoint of the scale and higher than all other emotions including anger. The autonomy and community violations elicited very low grossed out ratings, consistent with the notion that participants may reserve the term *grossed out* for physical stimuli.

Another study provides converging evidence that pure moral transgressions elicit disgust in addition to anger (Simpson, Carter, Anthony, & Overton, 2006). Participants were presented with photographs depicting physical disgust stimuli (e.g., maggots, vomit) or moral transgressions (e.g., ethnic cleansing, child abuse), with accompanying verbal descriptions. The moral photographs did not portray any physical disgust stimuli (P. Overton, personal communication, May 5, 2011). Participants were asked to self-report on disgust, anger, and several other emotions, using Likert-type scales.

This method revealed strong and nearly equivalent ratings of both anger and disgust toward the moral photographs. Physical disgust photographs elicited similar ratings of disgust but low ratings of anger. These results point to an interesting difference between moral and physical disgust: Moral stimuli may often elicit a complex mix of negative emotions, but physical disgust can be a more isolated experience. Simpson et al. (2006) also found that disgust toward the physical photographs habituated somewhat over a 30-min period following the experiment, while disgust toward the moral photographs actually rose. The interpersonal nature of the moral stimuli may have led to increased rumination compared to the physical stimuli.

A final study that found substantial disgust and anger toward pure moral transgressions collected continuous self-reports of disgust, revulsion, and sickness toward transgressions such as a coercive relationship between a boss and an employee and a scientist feeding an experimental drug to her guests without their knowledge (Gutierrez, Giner-Sorolla, & Vasiljevic, 2012). Physically disgusting versions of the transgressions were also presented (e.g., a consensual workplace relationship between a 20-year-old male and a 76-year-old female and a scientist feeding cloned human flesh to her guests without their knowledge). Not surprisingly, the physical disgust scenarios elicited stronger self-reports of disgust than the pure transgressions, as they contained both transgressions and physical disgust stimuli. However, even though the disgust self-report measure contained words that may be more strongly associated with physical disgust than with moral disgust (i.e., revulsion and sickness), the pure transgressions elicited self-reports of disgust that were above the midpoint of the scale. Importantly, self-reports of disgust were higher than at least some other negative emotions, including sadness and pity, suggesting that disgust toward pure transgressions does not reflect just general negative arousal.

An interesting extension of research showing that pure transgressions can evoke disgust is a study (Young & Saxe, 2011) that examined the effects of intent on continuous ratings of disgust toward both physically disgusting transgressions (incest) and pure

transgressions (poisoning someone or feeding someone a dish to which he or she is allergic). Young and Saxe varied whether the transgression was performed intentionally or unintentionally. Unsurprisingly, participants reported more disgust toward incest than toward the pure transgressions, although intentional pure transgressions, such as deliberately harming someone, still evoked self-reports of disgust above the midpoint of the scale. Interestingly, however, intent had different effects on pure and physically disgusting transgressions. Although intentionally performing a pure transgression evoked stronger disgust than unintentionally performing the same act (L. Young, personal communication, September 13, 2011), levels of disgust were equivalent for intentional and unintentional incest. Thus, disgust toward physically disgusting transgressions appears to behave somewhat differently than disgust toward pure transgressions, as far as the effects of intent are concerned. A caveat is that self-reports of disgust toward incest were near the top of the scale, raising the possibility of ceiling effects.

It also remains unclear whether differences in intent affect disgust independently of anger. As we discuss shortly, there is considerable shared variance between self-reports of disgust and anger toward moral transgressions (Gutierrez et al., 2012). We find this fact interesting in and of itself—why should a withdrawal-related emotion rooted in the avoidance of disease (i.e., disgust) share variance with an approach-related emotion rooted in social wrongs (i.e., anger; Carver & Harmon-Jones, 2009)? That said, there is some evidence that manipulations of intent may primarily affect variance that is shared between disgust and anger rather than variance that is unique to disgust (Gutierrez et al., 2012; Russell & Giner-Sorolla, 2011). On the other hand, it is somewhat doubtful whether the pure “transgression” stimulus used in this study—serving a guest beef when the guest believed it to be mutton—is really a moral transgression at all. As well, this study used a measure of disgust that may have been biased against moral disgust (i.e., a composite of “disgusted,” “repulsed,” “sickened,” and “grossed-out”).

In summary, differences in the wording of self-report questions and the forced-choice versus continuous nature of disgust measures may account for discrepancies among previous self-report studies of moral disgust. When asked in a way that is not biased against physical disgust, participants appear to strongly endorse disgust toward moral transgressions, even when the stimuli do not contain reminders of physical disgust.

Although the studies just described all examined self-reported disgust in adults, developmental research also exists. Children ages 6 to 9 were asked whether a variety of different situations could be called “disgusting” (Danovitch & Bloom, 2009). The stimuli were short scenarios describing age-appropriate moral transgressions (e.g., making an unfair rule), as well as physical disgust scenarios (e.g., touching a worm), neutral scenarios (e.g., touching a rock), and control negative scenarios (e.g., failing a test in school). The physical disgust scenarios were endorsed more strongly as disgusting than the moral transgressions. Importantly, however, across two studies, children of all ages endorsed the moral transgressions as disgusting more often than the negative control and neutral scenarios. In other words, children did not indiscriminately refer to all negative stimuli as disgusting, but they did judge that moral transgressions could be called disgusting. One caveat is that a substantial proportion of children (53% in Study 1 and 37% in

Study 2) did not endorse any moral transgression as disgusting. This could be related to trait individual differences, which we discuss further below. It is also possible that the developmental trajectory for moral disgust extends beyond the age range examined in this study. Indeed, physical disgust appears to develop rather slowly across childhood (Fallon, Rozin, & Pliner, 1984; Rozin, Hammer, Oster, & Horowitz, 1986). It seems plausible that moral disgust could also have a protracted developmental time course.

Self-report studies of children and adults thus provide some initial evidence that pure moral transgressions can indeed evoke disgust. However, one potential concern with these data is that verbal self-report may not distinguish well between disgust and other negative emotions. In particular, there is some evidence that self-reports of “disgust” may not cleanly separate disgust from anger. As mentioned, asking participants to recall an instance in which they felt “disgust” or “disgusted” elicits descriptions of both moral transgressions and physical disgust stimuli (Nabi, 2002). Notably, these prompts also evoked anger-related action tendencies, such as a desire to hit someone or overcome an obstacle (Nabi, 2002). As well, verbal self-reports of disgust toward pure moral transgressions (e.g., a coercive workplace relationship) are strongly predicted by verbal self-reports of anger (Gutierrez et al., 2012). Although these findings could indicate that moral disgust and anger are frequently experienced together, an alternative explanation is that English-speaking participants may simply use the words “anger” and “disgust” interchangeably (Nabi, 2002).

If the latter interpretation is correct, it could be that participants who report disgust to pure moral transgressions are actually experiencing anger. Accordingly, several researchers have explored endorsement of emotional facial expressions as an alternative to verbal self-report. In these experiments, participants are presented with a number of emotional facial expressions and asked whether each is consistent with their experience. The best validated disgust facial expression involves raising of the upper lip and/or wrinkling of the nose, actions that are produced by two different branches of the levator labii superioris muscle (Ekman & Friesen, 1978). This expression is reliably and cross-culturally recognized as disgust (Ekman et al., 1987; Ekman, Sorenson, & Friesen, 1969; Tracy, Robins, & Schriber, 2009). It tracks the participant’s experience of disgust but not anger (Ekman, Friesen, & Ancoli, 1980; Vrana, 1993) and differs from the best validated anger expression, in which the brows are lowered and the lips are pressed together to form a thin line (Ekman & Friesen, 1978; Tracy et al., 2009). Moreover, verbal self-reports of disgust in response to pure moral transgressions (e.g., a coercive workplace relationship) are predicted by endorsement of disgust facial expressions but not anger expressions, even when controlling for verbal self-reports of anger (Gutierrez et al., 2012). Self-reports collected using endorsement of disgust facial expressions may thus offer a better separation of disgust and anger experience than traditional verbal self-reports.

Using the expression endorsement methodology, two studies in adults and one in children provide evidence that disgust evoked by moral transgressions is not just anger in disguise. Adult participants who received unfair offers in an economic game strongly endorsed a disgust expression from a well-validated set (Matsumoto & Ekman, 1988) as consistent with their experience (Chapman et al., 2009). Manipulation checks confirmed that the disgust expression was viewed as the best fit for emotion descriptors such

as “tasting something bad” and “smelling something bad.” These results imply that participants viewed the experience of being treated unfairly as similar to olfactory or gustatory forms of disgust. Participants also endorsed angry and sad expressions in response to unfair monetary offers, although to a lesser extent than disgust.

Expression endorsement has also been used to measure disgust toward written scenarios (Gutierrez et al., 2012). Verbal report findings from this study are described above; participants also provided expression endorsement ratings for anger and disgust. Ratings were made on a Likert-type scale, and participants were also asked to select the one expression that best described their feelings about the scenario. Pure moral transgressions (e.g., a coercive workplace relationship; using guests as guinea pigs) elicited substantial disgust endorsement as well as anger endorsement. However, when asked to select the one expression that best fit their feelings, participants predominantly selected the anger expression (46%) rather than the disgust expression (21%). This latter result fits with the idea that categorical choices between emotion terms may underestimate disgust toward pure moral transgressions.

The study of children comes from the developmental work described above (Danovitch & Bloom, 2009). In the relevant experiment, children ages 6 to 9 were asked whether a disgust expression taken from a widely used set (Ekman & Friesen, 1975a) could “go with” physical disgust stories, pure moral transgressions, and neutral scenarios (examples given above). The disgust expression was endorsed most frequently for physical disgust, indicating that children understood the basic meaning of the expression. However, children also endorsed the disgust expression for the moral transgressions to a greater extent than the neutral scenarios.

The studies just described suggest that both children and adults endorse disgust facial expressions as appropriate for pure moral transgressions. However, there is one contradictory set of results (Rozin, Lowery, et al., 1999). In this experiment, participants read scenarios that depicted community, autonomy, and divinity violations, and they were asked to select the most appropriate face for each scenario from among two variants of an anger expression, two variants of a contempt expression, and two variants of a disgust expression. The expression photographs were developed by Rozin et al. Presumably, responses for both variants of each expression were combined, although this was not specified in the discussion of methods section. Only a small proportion of participants (8–18%) selected the disgust expressions as most appropriate for the community and autonomy violations. Many more (53–71%) chose the disgust expression for the divinity violations, which reference physical disgust stimuli.

As discussed above, it may be that asking participants to select the one expression that best fits a particular stimulus category tends to underestimate moral disgust. Another potential limitation of this study is that one of the anger expressions included the upper lip raise (facial action unit [AU] 10 according to the Facial Action Coding System; Ekman & Friesen, 1978). Although AU 10 is sometimes suggested as part of the anger expression (Ekman & Friesen, 1978; Rozin, Lowery, & Ebert, 1994), it is not included in the most recent, well-validated, and widely used photographs of emotional expressions (Matsumoto & Ekman, 1988; Tracy et al., 2009). The upper lip raise is thus not required to recognize anger

and may instead be more strongly associated with disgust. As a result, “anger” expressions that include the upper lip raise may actually communicate both anger and disgust. The other anger expression used by Rozin et al. (1999) did not include the upper lip raise, but the data were not presented separately for the two expressions. It is therefore difficult to interpret the meaning of anger endorsement in this study.

To summarize the complete body of self-report studies, we believe that the balance of the evidence comes out in favor of disgust toward pure moral transgressions. Five out of seven studies of verbal self-report are consistent with the idea that “pure” moral transgressions can evoke disgust, and methodological differences may account for the negative results of the other two studies. Similarly, three out of four studies of expression endorsement support disgust toward pure moral transgressions, and the fourth is difficult to interpret. Thus, when people are asked whether they find pure moral transgressions disgusting, the answer seems to be “yes.”

Implicit and expressive measures of disgust. The previous section illustrates that measuring disgust via self-report is not as straightforward as it might initially seem. As an alternative, a growing number of researchers have used implicit and expressive measures to examine moral disgust (see Table 1). This type of work is almost uniformly consistent in supporting disgust toward pure moral transgressions.

One approach has been to examine word-stem completion, either for stems that could be completed as disgust words (e.g., STI__ could be completed as STINK or STING) or for stems that could be completed as cleaning-related words (e.g., S __ P could be completed as SOAP or SLIP). In one study, participants who read vignettes describing criminals completed more disgust- and cleaning-related word stems than participants who read vignettes describing neutral situations (Jones & Fitness, 2008). In another study, participants who recalled a moral transgression that they committed were more likely to complete cleaning-related word stems (Zhong & Liljenquist, 2006). Thus, priming morality appears to activate disgust and cleaning-related concepts. Importantly, the moral stimuli in these experiments do not appear to have contained reminders of physical disgust.

Another implicit measure that has been examined is preference for cleaning or personal hygiene products, the rationale being that disgust may activate a desire to cleanse. Participants who read criminal vignettes were more likely to choose soap or an antiseptic wipe as a gift, rather than an equally desirable pencil holder (Jones & Fitness, 2008). Similarly, participants who recalled a moral transgression that they had committed were more likely to choose an antiseptic wipe versus a pencil (matched in preinduction preference) than were participants who recalled a prosocial act (Zhong & Liljenquist, 2006). Finally, participants who copied a story describing a moral transgression (sabotaging a coworker to obtain a desired promotion) rated the desirability of cleaning products such as soap and toothpaste as higher than did participants who copied a prosocial story (Zhong & Liljenquist, 2006).

These results are consistent with the idea that moral transgressions may activate disgust-related cognitive and behavioral processes. However, one potential concern is the specificity of these implicit measures to disgust. In particular, it could be that any negative emotional state might prime a wide range of negative emotion concepts, including disgust. Similarly, general negative

affect could activate a range of nonspecific behaviors aimed at reducing negative emotion: Cleaning behaviors could be among this set. Future studies could test this possibility by including implicit measures that are related to other emotions, such as anger or sadness, in addition to disgust and cleansing.

A measure that may better discriminate between disgust and other negative emotions is disgust facial behavior. In particular, as mentioned above, raising of the upper lip and wrinkling of the nose are believed to be key components of the disgust facial expression, as opposed to anger (Ekman et al., 1980, 1987; Vrana, 1993). In the first study to examine whether moral stimuli result in the upper lip raise and nose wrinkle (Rozin, Lowery, et al., 1999), the experimenter read aloud scenarios describing community, authority, and divinity violations, and participants were asked to pose the facial expression that was appropriate to each situation. Expressions were examined with a visual coding scheme, the Facial Action Coding System (FACS; Ekman & Friesen, 1978).

To analyze the results, Rozin, Lowery, et al. (1999) made use of behavioral data from an earlier experiment in the article, in which a different group of participants first read definitions of the community, autonomy, and divinity moral domains and then assigned each scenario to a domain. The frequency with which the scenarios were assigned to the predicted domain was computed. These frequencies were correlated with the frequency of the different facial actions to analyze the facial expression data. The measure thus represents something like the correspondence between facial actions and how often each scenario was assigned to the theoretically correct domain. According to this measure, the nose wrinkle and upper lip raise were negatively associated with the community and autonomy domains and positively correlated with the divinity domain (whose scenarios presented physical disgust stimuli). This correlation measure is somewhat difficult to interpret, however. A more transparent index might be the frequency of disgust-related facial actions across the three types of scenarios, but this was not presented. The validity of posed facial expressions is also unclear: Participants may not have explicit, free-recall knowledge of what their face should look like in response to moral transgressions.

More recent work has examined facial responses to moral transgressions using electromyography (EMG; Chapman et al., 2009). This research focused on EMG activation of the levator labii superioris (LL) muscle, which is responsible for raising the upper lip and wrinkling the nose. EMG was recorded while different groups of participants sampled distasteful liquids (tapping gustatory distaste), viewed photographs of physical disgust stimuli (tapping physical disgust), and received real monetary offers of varying fairness in an economic game (tapping morality). LL activation was found to increase with increasing self-reports of gustatory unpleasantness, with increasing self-reports of disgust in response to photographs of physical disgust stimuli, and with increasing unfairness of offers in the economic game, strongly predicting offer rejection. Thus, a facial action observed in response to distasteful liquids and physically disgusting photographs was also associated with the perception of unfair behavior toward the self.

Importantly, the LL was specific to these particular motivational and affective states. LL activation was not associated with the intensity or positive valence of responses to the liquids, with self-reports of sadness elicited by sad photographs, or with self-reports of anger or contempt during the economic game. LL

activation may thus be a specific indicator of distaste and disgust, extending into moral disgust elicited by unfair treatment.

The extension of LL activation to moral disgust has been replicated in a study that used scenarios as stimuli (Cannon, Schnall, & White, 2011). Scenarios describing unfair behavior (e.g., cheating at cards) resulted in stronger activation of the LL than did fair scenarios, and LL activation was correlated with judgments about the negative valence of the actions described. Interestingly, LL activation was specific to fairness and purity: Scenarios describing harm and violations of community and authority norms did not result in LL activation.

One concern with studies of facial responses to moral transgressions is that facial signs of elevated disgust could actually reflect metaphorical communication, conveying strong condemnation without actually indicating the subjective experience of disgust (Fridlund & Russell, 2006; Royzman & Kurzban, 2011). If this was the case, however, we would expect the disgust expression to be most strongly activated in response to moral transgressions (which are highly social), relative to physical disgust (Chapman & Anderson, 2011). However, the reverse is true (Chapman et al., 2009). Furthermore, levator labii activation was correlated with self-reports of disgust upon being treated unfairly (Chapman et al., 2009). Thus, even if LL activation was purely communicative, it is correlated with subjective experience.

Evidence from other methodologies is also helpful in addressing whether moral disgust is felt or just communicative. For example, it seems unlikely that increased completion of word stems with disgust- or cleansing-related words after exposure to moral transgressions (Jones & Fitness, 2008; Zhong & Liljenquist, 2006) could represent a communicative act (similarly for increased preference for cleansing products; Jones & Fitness, 2008; Zhong & Liljenquist, 2006). Moreover, developmental research also argues against a communicative interpretation of disgust toward moral transgressions (Danovitch & Bloom, 2009). As mentioned, children as young as 6 years of age reported that moral transgressions could be called disgusting. Importantly, there was no effect of age on endorsement of moral transgressions as disgusting. Because children's use of metaphor develops rapidly in early childhood, if their use of the term "disgusting" to describe moral transgressions was metaphorical, we would expect it to increase with age as well (Danovitch & Bloom, 2009). The lack of an age effect therefore argues against the view that moral disgust represents a form of metaphorical communication, rather than disgust experience.

Although moral disgust does not seem to be "just" metaphorical communication, it could well be a metaphor in a deeper, more compelling sense. In particular, theories of embodied cognition propose that abstract concepts or knowledge are grounded in modality-specific perceptual and motor systems (Barsalou, 1999; Clore & Schnall, 2008; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005; Semin & Cacioppo, 2008). For example, in an embodied view, the concept "hammer" includes representations of how a hammer feels in the hand, the motor patterns associated with its use, and so on. Although "hammer" is a concrete concept, our ability to understand more abstract concepts and emotions may also depend on such embodied representations (Barsalou, 1999; Lakoff & Johnson, 1999). For example, it has been argued that our understanding of interpersonal warmth—whether someone is a warm or cold person—may be based on concrete experiences of physical warmth (Williams & Bargh,

2008). Applied to the issue of moral disgust, this reasoning suggests that we may understand interpersonal repugnance based on experiences of physical repugnance. In other words, moral disgust may indeed be a metaphor but one that is genuinely grounded or embodied in the facial motor program of physical disgust.

Summary

In this section we have been concerned with studies that manipulate morality and measure disgust. Overall, a pattern is beginning to emerge in which participants who are exposed to moral transgressions show signs of disgust in many modalities, from self-report, to facial expression, to overt behavior and implicit priming. Moral disgust does not seem to be restricted to transgressions that reference physical disgust and also cannot be easily explained away as metaphorical communication. That said, many of the individual studies that point to this conclusion have limitations, and the literature is not without conflicting results that will have to be reconciled. Taken together, however, the studies reviewed above demonstrate substantial convergence on the idea that moral transgressions do elicit disgust.

Does Incidental Disgust Influence Moral Judgment? Manipulating Disgust, Measuring Morality

The studies reviewed so far have all adopted a forward approach to the question of moral disgust, examining whether exposure to moral transgressions elicits disgust. The case for a connection between disgust and morality would be strengthened if the link works in the reverse direction as well; that is, if manipulating disgust has an influence on moral cognition. Such a demonstration would also suggest that disgust plays a causal role in moral judgment.

To address this issue, a number of studies have examined whether experimentally evoked physical disgust can bias moral judgments, rendering them more severe (see Table 2). As with the studies that manipulated morality and measured disgust, a key question here is whether evoking physical disgust can influence judgments about a wide range of moral issues or only those that contain reminders of physical disgust. To us, it is less compelling if incidental physical disgust influences only those judgments about transgressions that contain physical disgust reminders. This would tell us only that priming physical disgust makes physically disgusting things even more aversive, which is hardly surprising.

Another important question is whether any effects of physical disgust on moral judgment are specific to disgust. That is, would any negative emotion have a similar effect? This issue is more difficult to deal with, as disgust is not the only emotion that is associated with morality. Accordingly, we see no reason that physical disgust must be the only emotion that can influence moral judgment. That said, if another emotion were found *not* to influence judgment, our confidence in the specificity of disgust effects would be increased.

Studies of Incidental Disgust

In the first study to manipulate disgust and measure morality, highly susceptible participants were placed under a posthypnotic suggestion to feel “a pang of disgust . . . a sickening feeling in [the]

stomach” upon encountering a neutral trigger word (*often* or *take*, counterbalanced across participants; Wheatley & Haidt, 2005, p. 780). The trigger word was then embedded in vignettes describing moral transgressions. Two of the vignettes were related to physical disgust (sex between second cousins, eating a dead dog), and four were not (shoplifting, stealing library books, taking bribes, an ambulance-chasing lawyer). Participants who read vignettes containing the trigger word reported experiencing more disgust and also judged the transgressions to be more wrong than did participants who read the same vignettes without the trigger word. This effect was seen for both the physically disgusting and the nondisgusting transgressions. The disgust manipulation did not affect nonmoral judgments (e.g., general feelings about objects in the story). These data imply that evoked physical disgust may specifically affect moral judgments, rather than rendering all kinds of evaluations more negative.

This pattern of results has been replicated with a variety of more conventional disgust elicitors, including exposure to an unpleasant odor, a dirty room, recall of disgusting events, and viewing a disgusting film (Schnall, Haidt, Clore, & Jordan, 2008). Interestingly, the disgust manipulation affected moral judgment only in participants who were highly attuned to sensations from their body, as measured by the Private Body Consciousness subscale of the Body Consciousness Questionnaire (Miller, Murphy, & Buss, 1981). Also of interest is that each of the four disgust induction procedures had an equivalent effect on physically disgusting transgressions (e.g., sex between first cousins) and pure transgressions (e.g., faking a résumé). Last, this study provides some evidence that it is disgust specifically, and not just any negative emotion, that affects moral cognition. In particular, participants who viewed a sad film clip did not make more severe moral judgments (Schnall, Haidt, et al., 2008).

Also providing evidence that the effects of incidental disgust are distinct from those of other negative emotions is a study that compared participants who experienced a disgust induction (viewing a disgusting film clip or sitting in a malodorous room) to those who experienced an anger induction (receiving bogus negative feedback on essays; Ugazio, Lamm, & Singer, 2012). Control participants viewed a neutral film or received neutral feedback. Participants then made moral judgments (permissible/not permissible) about the physically disgusting transgressions from the study by Schnall, Haidt, et al. (2008) that was just described, as well as about pure transgressions (e.g., poisoning someone) and moral dilemmas (e.g., sacrificing one to save many). Ugazio et al. failed to replicate Schnall, Haidt, et al.’s finding that incidental disgust increases the severity of judgments about physically disgusting transgressions. However, participants in the disgust condition did judge that utilitarian actions in moral dilemmas were less permissible than did participants in the neutral control conditions or in the anger condition.

These three studies examined the effects of physical disgust on moral judgment, but the influence of distaste has also been investigated (Eskine, Kacirik, & Prinz, 2011). Participants drank a bitter, sweet, or neutral liquid before making judgments about the same vignettes used by Wheatley and Haidt (2005). Participants in the bitter condition judged that the transgressions were more wrong than did those in the sweet or neutral conditions, which did not differ from one another. This pattern did not differ between the physically disgusting and pure transgressions (K. Eskine, personal

communication, July 20, 2011). One important and striking aspect of these findings is that the distaste induction is very far removed from physical or interpersonal disgust, such as sitting in a dirty or malodorous room, which might be perceived not as only physically disgusting but as personally offensive. As such, these findings suggest that the relationship between disgust and morality extends as far back as disgust's proposed chemosensory origins in distaste.

In addition to scenario-based experiments, two studies have examined the effects of incidental disgust on behavior during the ultimatum game (UG). In UG paradigms, two players are asked to split a sum of money (e.g., \$10) between them. One player, the "proposer," makes an offer as to how the money should be split. The other player, or "responder," can either accept the offer, in which case the money is split as proposed, or reject the offer, in which case neither player receives anything. The UG is an interesting laboratory model of morality, since responders feel that very unequal offers are unfair (Pillutla & Murnighan, 1996), and such offers are often rejected (Güth, Schmittberger, & Schwarze, 1982). Responders pay a cost to reject an unequal offer, because they would receive a small amount of money by accepting the offer but get none if they reject it.

As described above in the section on self-reports, previous work suggests that participants experience unfair monetary offers as disgusting: Both facial and self-report measures of disgust increase with increasing inequality of offers (Chapman et al., 2009). Turning this paradigm on its head, two studies have examined whether inducing disgust has an effect on responders' tendency to reject unequal offers. Moretti and di Pellegrino (2010) manipulated disgust by having separate groups of participants view disgusting, sad, or neutral photographs before playing 12 rounds of the UG. Participants in the disgust condition accepted fewer unequal offers than did participants in the sad or neutral conditions, which did not differ from one another. Participants in the disgust condition also rated unequal offers as less fair than did participants in the sad or neutral conditions.

The influence of disgust on UG responding has been replicated with a different emotion-induction procedure (Harlé & Sanfey, 2010). In a between-subjects design, participants saw short film clips designed to evoke disgust, serenity, amusement, or anger, after which they played 16 rounds of the UG. Acceptance of unequal offers was lowest for disgust, followed by serenity (another withdrawal-related emotion). Acceptance rates for the two approach-related emotions—anger and amusement—did not differ significantly from a neutral control condition.

The scenario-based and UG studies just described support the idea that incidental physical disgust and distaste can influence moral judgments, including judgments about pure transgressions that do not refer to physical disgust. However, one study provides conflicting evidence on the latter point (Horberg et al., 2009). In this research, participants viewed a physical disgust or sad film clip and then made wrongness judgments about "purity" violations (e.g., sexual promiscuity, keeping a dirty living space) and "harm/care" violations (e.g., kicking a dog, ridiculing a stranger). Relative to participants in the sad condition, those in the disgust condition judged the purity violations, but not the harm/care violations, to be more wrong. It is not clear why these findings differ from previous studies, in which induction of disgust influenced physically disgusting and nondisgusting transgressions equivalently. One possibility, as described above, is that individual dif-

ferences in private body consciousness might be an important modulating variable. For example, incidental disgust may influence only those judgments about nondisgusting transgressions in individuals with high private body consciousness, but physically disgusting transgressions might be susceptible to the influence of incidental disgust in a larger part of the population (Schnall, Haidt, et al., 2008). Another potential explanation is that disgust has been tied to specific types of moral transgressions (e.g., fairness and purity but not harm; Cannon et al., 2011). As such, incidental disgust should have its greatest influence on these moral domains but not on unrelated ones.

A final study that used a rather different disgust induction procedure failed to replicate any influence of incidental disgust on moral judgment (David & Olatunji, 2011). In an evaluative conditioning procedure, a previously neutral word (*part*) was repeatedly presented with physical disgust photographs to form the conditioned stimulus (CS). Another neutral word (*some*) received no pairings. A manipulation check confirmed that *part* but not *some* evoked feelings of disgust after the conditioning procedure. *Part* and *some* were inserted into vignettes modified from Wheatley and Haidt (2005), and participants rated how wrong and how disgusting they found each transgression. Although vignettes that contained the CS were rated as more disgusting than vignettes that contained the unpaired word, CS vignettes were not judged to be more wrong.

One possible explanation for the null finding is that the disgusting images that were used in the conditioning procedure depicted mutilations, and most of the other experiments used disgust stimuli more closely tied to contamination (e.g., bad tastes and odors, photographs and films of body products; Eskine et al., 2011; Harlé & Sanfey, 2010; Moretti & di Pellegrino, 2010; Schnall, Haidt, et al., 2008; Ugazio et al., 2012). This raises the important possibility that forms of disgust related to blood and injuries could be less closely tied to morality than disgust related to food and other body products. Other methodological differences, such as the strength of the disgust induction or awareness of the experimental design, could also account for the results. In summary, conflicting results as to the effect of incidental disgust may suggest that not all transgressions are equally susceptible to the influence of disgust and that not all evocations of physical disgust have equal influence.

Studies of Incidental Cleanliness

A complementary approach to manipulating disgust is to manipulate physical cleanliness, on the logic that cleanliness is the conceptual opposite of disgust. Indeed, as discussed in the section on self-reports, multiple sources of evidence suggest that exposure to a moral transgression results in an impulse to cleanse one's self. The studies described next have examined the consequences of being allowed to indulge this impulse. One caveat is that cleanliness might be related to other emotions besides disgust. For example, cleansing might reduce anxiety or increase positive emotions. Whatever the mechanism, several studies have now shown an effect of cleanliness on moral judgments. However, as described next, the direction of the effects remains unclear: Some researchers have found that cleanliness makes moral judgments less severe, and others have found the opposite.

On the side of decreasing judgment severity due to cleanliness are the first two experiments to examine cleanliness effects. In one, participants unscrambled cleanliness-related words (e.g., *pure*, *washed*, *clean*) and neutral words (Schnall, Benton, & Harvey, 2008). They next rated the wrongness of physically disgusting transgressions (e.g., eating a dead dog, cannibalism) and pure transgressions (e.g., keeping a lost wallet, falsifying a résumé). Half of the transgressions were described in the third person (i.e., they were performed by someone else), and half were described in the first person. Participants in the cleanliness condition rated both the physically disgusting and the pure transgressions as less wrong than did participants in the control condition. Schnall et al. did not examine whether these effects differed between first- and third-person transgressions. In the second experiment, participants first watched a physically disgusting film (Schnall, Benton, & Harvey, 2008). Before rating the vignettes described above, half of the participants washed their hands with soap and water; the other half did not. Participants who washed their hands rated the physically disgusting and pure transgressions as less wrong than did participants in the control condition.

On the opposite side are several experiments that have found that cleansing increases the severity of moral judgment. Participants who cleaned their hands rated a number of social issues (e.g., smoking, using drugs, littering) as more immoral than did participants who did not clean their hands (Zhong, Strejcek, & Sivanathan, 2010). Participants who visualized themselves as being physically very clean rated similar social issues as being more wrong than did participants who visualized themselves as being dirty. Zhong et al. suggest that these findings could represent a moral licensing effect of physical cleanliness, mediated by the influence of cleanliness on moral self-image. That is, if being clean enhances one's own moral self-image, one can render harsh judgments on others.

Similar results were found in a study in which participants were asked to make judgments about sexually disgusting transgressions (e.g., consensual incest, masturbating with a teddy bear), nonsexual disgusting transgressions (e.g., giving a homeless person a moldy sandwich), and pure transgressions (e.g., evading taxes because of medical expenses; Helzer & Pizarro, 2011). All transgressions were third person (i.e., carried out by someone else). Compared to participants who did not clean their hands, participants who cleaned their hands judged the sexual transgressions, but not the other two types of transgressions, to be more wrong. Helzer and Pizarro suggest that cleansing may increase vigilance toward potential contaminants, both physical and moral. Much as individuals may want to avoid dirtying themselves after washing their hands, they may also want to maintain their moral cleanliness after washing. This could motivate avoidance or rejection of transgressions that are more closely associated with physical disgust, such as sexual transgressions.

The paragraphs above illustrate that there is an approximately equal split between studies reporting increased and decreased severity of judgment due to cleanliness manipulations. Also unclear is whether cleanliness effects are limited to transgressions that are related to physical disgust, such as sexual transgressions. There are a number of differences between the studies that could potentially account for divergent results. First, different studies have used different items to examine moral judgment. Zhong et al. (2010) presented single-word political issues; many of the items

presented by Helzer and Pizarro (2011) had no clear victim; and Schnall, Benton, and Harvey (2008) included a number of dilemmas with competing moral imperatives. It is possible that cleanliness could have a different impact on these different types of stimuli.

An interesting alternative, suggested by Zhong et al. (2010), is that it may matter whether it is the self or the transgressor who becomes more clean. Increased self-cleanliness may license more severe judgments of others' transgressions. By contrast, if the transgressor becomes more clean, his or her transgressions may not seem as bad. In both the Zhong et al. and Helzer and Pizarro studies, it was clearly the self who was cleansed. In the first experiment by Schnall, Benton, and Harvey, feelings of cleanliness due to unscrambling cleaning-related words could have been misattributed to the transgressor. In the second experiment by Schnall et al., the protocol began by evoking incidental disgust, which could have been misattributed to the transgressor in the scenarios presented subsequently. The cleansing manipulation may then have reduced feelings of disgust toward the transgressor.

Finally, it may also matter whether the transgression is carried out by the self or by someone else. The work by Schnall, Benton, and Harvey (2008) used a mix of first- and third-person transgressions, and Helzer and Pizarro (2011) used exclusively third-person scenarios. Zhong et al. (2010) used single-word descriptions of social issues, so it is not clear who the transgressor is. No study has yet directly compared the effect of a cleansing manipulation on transgressions carried out by the self versus another.

Summary

To date, almost all of the studies that have manipulated disgust or cleanliness have reported effects on moral judgment. These findings strengthen the case for a causal relationship between disgust and moral judgment, by showing that experimentally evoked disgust—or cleanliness, its opposite—can influence moral cognition. The largest outstanding issue is whether these manipulations influence both physically disgusting and pure transgressions or only transgressions that contain reminders of physical disgust.

The influence of incidental disgust and cleanliness on moral judgment raises the question of whether emotions may cause or even constitute moral judgments. This issue is currently a topic of debate in moral psychology (Huebner, Dwyer, & Hauser, 2009), and it is unlikely to be resolved by studies of disgust alone. However, the data on disgust and cleanliness manipulations are certainly compatible with a role for emotion in influencing moral judgment. At minimum, the studies reviewed here suggest that emotions such as disgust can have an important modulatory influence on moral judgments. Hence, they cannot be merely epiphenomena of a purely nonemotional moral judgment system. We discuss this issue further in the final section of the article.

Individual Differences: Does Variation in Disgust Toward Physical Stimuli Predict Moral Judgment?

So far we have considered studies that have manipulated morality and measured disgust, as well as studies that manipulated disgust (or cleanliness) and measured morality. This work has largely focused on disgust as a transient state. However, there are

also stable individual differences in the tendency to experience disgust toward physical stimuli (Haidt, McCauley, & Rozin, 1994; Olatunji, Williams, Tolin, et al., 2007; Tybur et al., 2009). Accordingly, it is relevant to ask whether differences in trait physical disgust are associated with differences in moral judgments or morally charged social orientations (see Table 3). Once again, we are especially concerned with whether trait physical disgust influences only transgressions that contain physical disgust reminders or pure transgressions as well.

Trait physical disgust, or disgust sensitivity, is most commonly assessed with all or part of the Disgust Scale (DS), a 32-item self-report questionnaire (Haidt et al., 1994). The DS measures an individual's tendency to experience disgust toward a variety of physical stimuli, including spoiled foods, body products such as feces and vomit, contact with death, blood and gore, minority sexual practices, and direct or indirect physical contact with strangers. As this list suggests, most of the DS is concerned with disgust evoked by rather concrete, physical stimuli. Hence, there is no a priori reason why scores on the DS should be related to abstract moral judgments. A correlation between scores on the DS and measures of moral judgment would therefore suggest a stable relationship between the physical disgust and moral cognition of an individual.

One potential objection to this logic is that the DS may simply reflect general negative affectivity or neuroticism, rather than disgust per se, and hence that any relationship between the DS and moral cognition may be not be specific to disgust. However, reported correlations between the DS and neuroticism are low to moderate: 0.23 in the original validation study ($N = 124$; Haidt et al., 1994), 0.27 in our own unpublished data ($N = 223$; Hirsh, Robinson, Chapman, Anderson, & Peterson, 2012), and 0.45 in one other study ($N = 132$; Druschel & Sherman, 1999). Moreover, as we will see, several studies examining DS effects on moral cognition have included other trait measures in an effort to rule out nonspecific effects of neuroticism.

A number of studies have shown that the DS has acceptable psychometric properties. The full-scale DS has good internal consistency, with Cronbach's alphas ranging from 0.80 to 0.87 across four samples ($N = 454$; Haidt et al., 1994). Little information is available on test-retest reliability, but scores obtained 2 months apart in a small sample ($N = 34$) were correlated at $r = .79$ (Rozin, Haidt, McCauley, Dunlop, & Ashmore, 1999). Convergent validity is unknown for the original DS, but the more recent 25-item version of the DS (Disgust Scale-Revised; Olatunji, Williams, Tolin, et al., 2007) shows good convergence with other disgust-related measures (Olatunji, Williams, Tolin, et al., 2007). Among them are the Disgust Emotions Scale (Kleinknecht, Kleinknecht, & Thorndike, 1997), which measures disgust toward common physical disgust stimuli, and scales measuring contamination concerns and washing compulsions from the Padua Inventory (Burns, Keortge, Formea, & Sternberger, 1996) and the Vancouver Obsessional Compulsive Inventory (Thordarson et al., 2004).

Normal Variation in Physical Disgust Sensitivity

Beginning our review of DS effects on moral judgment, normal variation in physical disgust sensitivity has been linked with attitudes toward crime and criminals. Participants who scored higher on a short version of the DS were more likely to vote "guilty" after

reading a fictional transcript of a murder trial (Jones & Fitness, 2008). Differences in trait anger did not influence verdicts. In another experiment, participants read vignettes describing criminal acts and suspected perpetrators (Jones & Fitness, 2008). Individuals higher in physical disgust sensitivity judged that suspects were more likely to have committed the crime, rated the suspects as more "evil," and recommended longer sentences. By contrast, trait anxiety did not predict these effects. In both studies, the crime stimuli did not contain reminders of physical disgust, suggesting that DS effects on moral judgment may not be limited to judgments about physically disgusting transgressions. Moreover, the vignettes used in the second experiment made no reference to death, so the effect of physical disgust sensitivity cannot be mediated by increased mortality salience, in spite of a proposed link among disgust, mortality salience, and moral condemnation (Goldenberg et al., 2001; Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989).

In addition to attitudes toward fictitious criminals, disgust sensitivity has been found to predict real-world social orientations. Higher disgust sensitivity is associated with greater self-reported political conservatism (Inbar, Pizarro, & Bloom, 2009), right-wing authoritarianism (Hodson & Costello, 2007; Jones & Fitness, 2008), and social dominance orientation (Hodson & Costello, 2007), which reflects a preference for hierarchy within social groups (Pratto, Sidanius, Stallworth, & Malle, 1994). One study has examined whether disgust sensitivity is associated with specific attitudes toward issues of importance to contemporary American society, including abortion, the death penalty, taxes, and gun control (Inbar, Pizarro, & Bloom, 2009). Of the 10 issues studied, higher disgust sensitivity specifically predicted more conservative attitudes toward abortion and gay marriage. Notably, leaving out all of the DS questions except for those concerning disgust toward foods and body products did not change this result. Thus, the effect of disgust sensitivity on these attitudes appears to be driven by a general proclivity toward physical disgust.

Given the association between disgust sensitivity and attitudes toward criminals (Jones & Fitness, 2008), the specificity of DS effects to gay marriage and abortion may appear somewhat surprising at first glance. However, crime was not among the issues examined by Inbar, Pizarro, and Bloom (2009), so the two findings are not necessarily contradictory. The effect of physical disgust sensitivity on attitudes toward homosexuality has recently been replicated in a study using implicit measures (Inbar, Pizarro, Knobe, & Bloom, 2009). However, this study did not compare DS effects on attitudes toward homosexuality with attitudes toward nonsexual moral issues. Because minority sexual practices are a physical disgust stimulus for members of the majority, this work cannot speak directly to DS effects on pure moral transgressions.

Continuing with the theme of physical disgust sensitivity and real-world moral-political attitudes, one study has examined the relationship between disgust sensitivity and attitudes toward outgroups (Hodson & Costello, 2007). Individuals who scored higher on interpersonal disgust items from the DS (i.e., those who are averse to physical contact with other people) were found to have more negative attitudes toward immigrants, foreign ethnic groups, and low-status outgroups. This relationship was mediated by an association between disgust sensitivity, right-wing authoritarianism, and social dominance orientation.

This last result implies that disgust may play a role not only in moral judgment and social orientation but also in prejudice. Indeed, the use of disgust language, but not angry language, appears to be elevated in hate texts relative to use of the English language as a whole (Taylor, 2007). Using a thesaurus, Taylor identified synonyms for the root words *anger* and *disgust*, as well as metaphor words related to social contamination (*cancer*, *poison*), more generic threats (*flood*, *swarm*), and other negative emotions such as hate, despair, envy, and fear. The frequency of the synonyms was then computed for seven texts that express extreme prejudice toward target groups (e.g., Hitler's *Mein Kampf*). Corrected frequencies in the hate texts were compared to whole-language frequencies from the British National Corpus (BNC; BNC Consortium, 2004). The only synonyms that were increased in hate texts relative to the BNC were *disgust*, *cancer*, and *hate*; synonyms for *anger* and other negative emotions were not significantly elevated. That said, the elevated use of *hate* is somewhat ambiguous, since it is not clear whether *hate* is more closely related to anger or disgust.

If disliked outgroups are indeed perceived as disgusting, and there is a link between disgust and morality, outgroups could be perceived as morally suspect. The social consequences of such a connection could be profoundly negative, leading to discrimination against outgroup members in the legal system as well as in other social domains. Consistent with an association between prejudice and disgust, the most extreme outgroups have been shown to evoke not only self-reports of disgust but also decreased brain activation in areas associated with person processing (Harris & Fiske, 2006), suggesting that disgust may be associated with dehumanization (Harris & Fiske, 2007; Hodson & Costello, 2007).

Although Haidt et al.'s (1994) DS does not explicitly assess disgust toward moral transgressions, a newly developed measure does just that. The Three-Domain Disgust Scale measures feelings of disgust toward contaminating stimuli such as body products, disease, and spoiled food ("pathogen disgust"); sexual practices such as watching pornography and hearing strangers having sex ("sexual disgust"); and nonphysically disgusting moral transgressions such as cheating and stealing ("moral disgust"; Tybur et al., 2009). Across four different samples totaling more than 2,000 individuals, moral disgust was consistently correlated with both sexual and pathogen disgust, with correlation coefficients ranging from 0.17 to 0.39.

The imperfect correlation between factors suggests that although the different types of disgust are related, they are not identical. Indeed, moral and physical disgust are differentially related to Big Five personality characteristics (Tybur, Bryan, Lieberman, Caldwell Hooper, & Merriman, 2011). While moral disgust is related to agreeableness and conscientiousness, pathogen and sexual disgust are (negatively) related to openness. As well, moral and sexual disgust are associated with primary psychopathy, but pathogen disgust is not (Tybur et al., 2009). Thus, despite a common core disgust sensitivity, there is evidence for differentiation between different kinds of disgusts as well.

Although most studies on this topic have found that the association between trait physical disgust and moral judgment holds for pure transgressions as well as those that contain physical disgust reminders, conflicting results come from a study that examined judgments about physically disgusting "purity" violations (e.g., keeping a dirty living space, being sexually promiscuous) and

nonphysically disgusting "justice" violations (e.g., expecting to be given special treatment, leaving small tips; Horberg et al., 2009). Disgust sensitivity was measured by asking participants how often in their daily life they felt grossed out, disgusted, and repulsed. Participants who scored higher on this measure endorsed stronger punishments for the purity violations but not the justice violations.

There are a number of potential explanations for the discrepancy between these findings and previous studies. First, the validity and reliability of the Horberg et al. (2009) disgust sensitivity measure are not known, nor is its relationship to the more widely used DS. Second, it is not clear whether the justice violations that were used are representative of the full range of nonphysically disgusting transgressions. For example, it may not be immoral to leave a small tip for bad service, and expecting special treatment may be an annoying personality quirk rather than a moral failure.

In summary, most studies of normal variation in trait disgust sensitivity have found an association with moral judgments about both physically disgusting and pure moral transgressions. More work is needed to better characterize the specific types of transgressions that are related to disgust sensitivity and also to examine whether specific subtypes of disgust sensitivity are differentially associated with moral judgment.

Pathological Variation in Physical Disgust Sensitivity

All of the studies described so far in this section have examined normal variation in the dispositional tendency to experience disgust. One clinical group that may show pathologically elevated disgust sensitivity is patients with obsessive-compulsive disorder (OCD). OCD is a disabling neuropsychiatric condition with a lifetime prevalence of 2–3% (American Psychiatric Association, 2000). Symptoms consist of obsessions, which are intrusive, recurrent, and unpleasant thoughts or impulses, and compulsions, which are repetitive behaviors or mental acts undertaken to neutralize the distress caused by the obsessions (American Psychiatric Association, 2000). OCD patients with contamination obsessions and compulsions appear to have heightened physical disgust sensitivity as measured by the DS (Olatunji, Williams, Tolin, et al., 2007; Woody & Tolin, 2002). This relationship remains significant after controlling for trait negative affect and depression (Olatunji et al., 2010; Olatunji, Williams, Lohr, et al., 2007; Tolin, Woods, & Abramowitz, 2006) and extends to normal variability in OCD-type symptoms (Mancini, Gragnani, & D'Olimpio, 2001; Moretz & McKay, 2008; Olatunji, Tolin, Huppert, & Lohr, 2005; Rozin, Taylor, Ross, Bennett, & Hejmadi, 2005; Thorpe, Patel, & Simmonds, 2003).

Given that OCD patients have heightened disgust sensitivity, we might expect that they would also show changes in moral judgment. Indeed, there is an association between the severity of OCD symptoms and concerns about committing moral transgressions (Olatunji, Abramowitz, Williams, Connolly, & Lohr, 2007), as measured by a questionnaire called the Penn Inventory of Scrupulosity (PIOS; Abramowitz, Huppert, Cohen, Tolin, & Cahill, 2002). As well, scores on the DS and PIOS are correlated (Olatunji et al., 2005). A limitation is that both of these studies examined variation in OCD-type symptoms and moral concerns in college-student samples. In sum, the small amount of evidence that is available suggests that elevated physical disgust related to OCD is associated with greater sensitivity to moral transgressions; how-

ever, further work is needed to validate this conclusion in clinical samples.

Two populations that may show pathological reductions in physical disgust sensitivity are patients with Huntington's disease (HD) and individuals with lesions of the insula, which is putatively key to physical disgust (Chapman & Anderson, 2012). However, in both cases the evidence on whether there is actually an impairment of physical disgust and the specificity of any such impairment to disgust is mixed. In HD, evidence exists on both sides (Hayes, Stevenson, & Coltheart, 2007; Johnson et al., 2007; Milders, Crawford, Lamb, & Simpson, 2003; Snowden et al., 2008; Sprengelmeyer et al., 1996). There are very few reports of patients with selective insular lesions, and these also provide conflicting results as to any effects on disgust sensitivity (Adolphs, Tranel, & Damasio, 2003; Calder, Keane, Manes, Antoun, & Young, 2000; Straube et al., 2010).

Until researchers can more firmly establish whether patients with insular lesion and individuals with HD truly represent low physical disgust populations, such cases cannot speak to whether abnormally low physical disgust is related to changes in moral judgment. However, it is worth considering what such neuropsychological data might be able to tell us, if the low-disgust status of these populations was confirmed. If future studies were to find that reduced physical disgust is *not* associated with changes in moral judgment, that would serve to demonstrate that physical disgust may be sufficient, but not necessary, for moral judgment. Such a conclusion is clearly sensible, as the entirety of one's moral calculus is surely not dependent on the integrity of the disgust response; nor is disgust the only emotion experienced in response to moral transgressions. The same conclusion need not follow about moral disgust toward transgressions, however. In particular, if moral disgust is related to physical disgust, we would expect that neuropsychological cases of reduced physical disgust should also have reduced moral disgust.

Summary

A number of studies have now shown that individuals who tend to experience stronger physical disgust also judge transgressions to be more wrong and hold more negative attitudes toward outgroups and certain moral-political issues. There is some evidence that this effect is not limited to transgressions that contain physical disgust reminders and that it is not due just to variation in neuroticism or other potential confounds with disgust sensitivity. Although the evidence on naturally occurring individual differences in physical and moral disgust is growing, additional research on neurological cases would be of great interest in determining whether reductions in physical disgust are directly related to decreases in moral disgust.

General Discussion

The research reviewed in the above sections has used a wide range of experimental approaches, and although individual studies are not without limitations, they are beginning to converge on the conclusion that disgust does indeed play a role in moral cognition. Research using self-reports and implicit measures suggests that moral transgressions evoke a subjective experience of disgust, that incidental physical disgust and cleanliness can bias moral judgment,

and that individual differences in physical disgust sensitivity are related to differences in moral judgment.

When drawing conclusions from this body of work, we cannot rule out the possibility of publication bias. In this light, we encourage researchers to publish negative as well as positive findings on moral disgust, to eventually facilitate meta-analysis. Having said that, we believe that publication bias is somewhat less likely in the case of moral disgust. In particular, provided that a study included a suitable comparison condition, failure to find disgust toward moral stimuli would not be a null finding. For example, consider a hypothetical study in which the researchers found evidence of disgust toward physical but not moral stimuli. This would represent a dissociation, not a null result, and as such should be publishable.

If physical and moral disgust are indeed related to one another, as previous work suggests, then just how similar are they? At one extreme, it could be argued that the disgust elicited by moral transgressions is identical to the disgust evoked by physical stimuli such as feces and vomit. There certainly are similarities between the two: For example, the subjective phenomenology of moral and physical disgust is similar enough that participants will label stimuli from both categories as "disgusting" (e.g., Hutcherson & Gross, 2011; Simpson et al., 2006) and match both to facial expressions of disgust that signal a bad taste or odor (Chapman et al., 2009; Danovitch & Bloom, 2009; Gutierrez et al., 2012). Physical and moral disgust activate common elements of the canonical disgust expression (Cannon et al., 2011; Chapman et al., 2009) and share at least partially overlapping neural substrates (Moll et al., 2005; Parkinson et al., 2011; Schaich Borg et al., 2008).

Differences also exist, however, and these are as important as the similarities. Terms such as *grossed out* are reserved for physical stimuli, suggesting that participants conceive of physical disgust as a partially distinct state (Hutcherson & Gross, 2011; Nabi, 2002). At the neural level, there are differences as well as similarities between physical disgust and moral judgment (Moll et al., 2005; Parkinson et al., 2011; Schaich Borg et al., 2008). Physical and moral disgust have distinct personality correlates (Tybur et al., 2011). Moral disgust is often accompanied by other negative emotions, and physical disgust may be elicited on its own more often (Simpson et al., 2006). Finally, moral disgust may persist for longer than physical disgust (Simpson et al., 2006).

What should we make of this pattern of similarities and differences? In particular, does the existence of differences undermine the notion that moral disgust is indeed a genuine form of disgust? We believe not. Instead, given the dramatically different stimulus triggers for physical and moral disgust, differences between the two are inevitable. We suggest that moral disgust may be best conceptualized as a specialized offshoot of physical disgust, designed to serve a social rather than a disease-avoidance function. As such, some modification of the original physical disgust blueprint is necessary, and this may account for the differences between physical and moral disgust.

A related issue is whether moral transgressions have to contain an element of physical disgust in order to trigger moral disgust. We have discussed this issue throughout the review, and on balance, our view is that that physical disgust stimuli are not necessary for moral disgust. To summarize, numerous studies have used transgressions that did not contain physical disgust stimuli and have

still found evidence of increased disgust in response to transgressions (Cannon et al., 2011; Chapman et al., 2009; Danovitch & Bloom, 2009; Hutcherson & Gross, 2011; Jones & Fitness, 2008; Zhong & Liljenquist, 2006), more severe moral judgments in response to evoked disgust (Eskine et al., 2011; Schnall, Haidt, et al., 2008; Ugazio et al., 2012; Wheatley & Haidt, 2005), and associations between disgust sensitivity and moral cognition (Hodson & Costello, 2007; Jones & Fitness, 2008; Tybur et al., 2009). Manipulations of cleanliness can affect judgments about transgressions that are unrelated to physical disgust (Schnall, Benton, & Harvey, 2008; Zhong et al., 2010). Several studies have also explicitly compared transgressions with and without elements of physical disgust and found no difference between responses to the two types of stimuli (Eskine et al., 2011; Jones & Fitness, 2008; Schnall, Haidt, et al., 2008; Wheatley & Haidt, 2005).

That said, evidence also exists to support the opposing view; namely, that disgust may be most strongly associated with transgressions involving bodily or sexual norms. Some studies have shown that differences in physical disgust sensitivity are more closely tied to judgments about sexual (Inbar, Pizarro, & Bloom, 2009) and bodily norm violations (Horberg et al., 2009) than other kinds of transgressions; in one case, a cleansing manipulation affected only judgments about sexual transgressions (Helzer & Pizarro, 2011). There is also work showing greater self-reported disgust in response to bodily norm violations (e.g., incest, necrophilia, eating human flesh) than to violations of nonbodily norms (e.g., testing a drug on unwitting subjects; Gutierrez & Giner-Sorolla, 2007; Russell & Giner-Sorolla, 2011). This latter research used standardized data that cannot speak to absolute levels of disgust, and it was not reviewed above. Standardized data can provide information on relative levels of disgust, however, and this work certainly suggests relatively higher disgust for purity violations.

Nonetheless, to us it is not really surprising or problematic if disgust does play an especially strong role in transgressions that involve the violation of bodily norms. After all, by definition, these contain physical disgust reminders, so we would expect them to elicit strong disgust and to be influenced by disgust manipulations. Moreover, there is ample evidence that other kinds of moral transgressions can elicit disgust. It also need not be the case that all types of transgressions are equally likely to elicit disgust. For example, there is some evidence to suggest that fairness violations may be most strongly associated with moral disgust (Cannon et al., 2011). This could account for some of the conflicting results just described.

A final point touched upon throughout the review is whether moral disgust might just be anger in disguise. On the one hand, self-reported disgust and anger toward pure moral transgressions often occur together (Gutierrez et al., 2012; Hutcherson & Gross, 2011; Simpson et al., 2006), suggesting substantial shared variance. On the other hand, there is evidence that anger and disgust can be dissociated. For example, participants playing an economic game showed activation of the levator labii (LL) facial muscle that was proportional to the degree of inequality they experienced (Chapman et al., 2009). Similarly, participants who read about others being treated unfairly also showed increased LL activity (Cannon et al., 2011). LL activation, which wrinkles the nose and/or raises the upper lip, is more typical of disgust than anger (Ekman et al., 1969, 1980, 1987; Tracy et al., 2009; Vrana, 1993).

Furthermore, in the economic game study, LL activation was correlated with subjective reports of disgust but not anger (Chapman et al., 2009). Experimental induction of disgust, but not anger, has also been found to increase rejection of unfair offers (Harlé & Sanfey, 2010).

Evidence from individual differences studies provides further support for a dissociation between anger and disgust: Trait physical disgust, but not trait anger, was found to predict the severity of moral judgments (Jones & Fitness, 2008). As well, experimentally inducing physical disgust causes utilitarian actions to be judged as less appropriate, relative to an anger induction (Ugazio et al., 2012). Finally, as will be discussed in more detail below, manipulating whether the victim of a transgression is the self or another differentially affects disgust and anger (Hutcherson & Gross, 2011). None of the moral stimuli in these experiments contained references to physical disgust stimuli, bodily norms, or sexual behavior.

In sum, there is reason to believe that even though moral disgust and anger are often coupled, they are actually distinct threads in the emotional response to moral transgressions, even those that do not involve physical disgust stimuli. Indeed, anger and disgust are associated with distinctive action tendencies: anger with approach (Carver & Harmon-Jones, 2009) and disgust with withdrawal (Rozin et al., 2000). Accordingly, it would not be surprising if they have different and potentially conflicting roles in moral cognition, as discussed in the final section of this review.

Outstanding Questions and Future Directions

The explosion of research on moral disgust in recent years has greatly increased our understanding of this emotion. A number of questions remain unanswered, however. In the next section we highlight two major, closely related issues: What is the function of moral disgust, and what causes moral disgust? We conclude by presenting three alternative models of moral disgust, with the aim of bringing together the diverse findings reviewed in this article and providing a framework within which to make sense of future research.

What is the function of moral disgust? One of the most intriguing features of moral disgust is that it is not clear why it exists at all. Why should an emotion originating in defense against toxicity and disease be triggered by a social stimulus? The mystery deepens when we consider that human beings already have a social emotion that seems tailored to respond to moral wrongdoing, namely, anger (Weiner, 2006). Why then do we feel disgust in response to moral transgressions?

As mentioned earlier, one possible answer to these questions stems from the contrasting action tendencies associated with anger and disgust (Haidt, Rozin, McCauley, & Imada, 1997; Hutcherson & Gross, 2011). Recent work suggests that anger is strongly associated with approach motivation, particularly when taking action may remedy the anger-provoking situation (Carver & Harmon-Jones, 2009). Moral anger may thus be associated with a tendency to approach and engage with transgressors, perhaps to punish them or otherwise decrease the probability of future transgressions (Fischer & Roseman, 2007). By contrast, physical disgust is usually seen as a withdrawal-related emotion, associated with a desire to distance oneself from the disgusting stimulus and avoid it in the future (Rozin, Haidt, & McCauley, 1999). If moral

disgust shares the withdrawal action tendency associated with physical disgust, it could serve a very useful function in moral contexts (Haidt et al., 1997; Hutcherson & Gross, 2011). In particular, moral disgust may provide an alternative to fighting or fleeing, enriching the individual's repertoire of social behaviors by adding a more passive rejection response. Recent game-theoretic modeling work suggests that rejection or avoidance may in fact be a more efficient strategy than active punishment, as the latter usually entails a risk or cost to the punisher (Ohtsuki, Iwasa, & Nowak, 2009).

In this light, we may also consider the alignment of physical disgust with parasympathetic activation (Ekman et al., 1983; Rozin et al., 2000), which serves to conserve and restore resources rather than expend them. In addition to discouraging the ingestion of poisons, for example, distaste may function to conserve the appetite for more nutritious sources of food (Pinker, 1997). Analogously, moral disgust may conserve an individual's resources by discouraging interaction with someone whose fundamental nature cannot be changed. Along these lines, although being angry at someone may support an incremental theory (Chiu, Dweck, Tong, & Fu, 1997; Dweck & Leggett, 1988) of a transgressor's behavior, consistent with the possibility of change (Weiner, 2006), disgust may support an entity theory, suggesting that the behavior is set in stone (Rozin et al., 2000).

Although some of these ideas have existed in the literature for years, we are aware of only one attempt to test the hypothesis that moral disgust and anger evoke contrasting action tendencies. Hutcherson and Gross (2011) asked participants to recall three types of situations: a time when someone else did something immoral that negatively affected the participant; a time when someone else did something immoral that did not personally affect the participant; and a time when someone else did something stupid or incompetent. Participants were asked about their feelings of disgust and anger, as well as approach-related action tendencies (whether the participant felt like putting in effort to stop the transgressor) and withdrawal-related action tendencies (whether the participant would go to some effort to avoid the transgressor). The relationship between emotions and action tendencies was of interest and did not interact with the type of situation that was recalled, so the three situation types were collapsed together for further analyses.

The results showed that anger, but not disgust, was associated with active attempts to stop an immoral behavior (i.e., with approach-related tendencies). However, disgust was not related to avoidance of transgressors; instead, anger was associated with being willing to expend effort to avoid the other person. Thus, these results do not support the idea that moral disgust and anger result in opposing action tendencies. A possible explanation is that the wording of the withdrawal-related question may have emphasized active, energetic avoidance (i.e., going to some effort to avoid the transgressor). Consistent with the idea that physical disgust might conserve resources through passive rejection, it is possible that moral disgust could be associated with more passive withdrawal or avoidance. This potential role for moral disgust in conserving the body and the expenditure of its resources remains an avenue for future investigation.

What is the cause of moral disgust? If moral disgust serves a particular function, it should be elicited in situations where that function is likely to be useful (Smith & Kirby, 2001). On this view,

some restricted category of moral transgressions may be most strongly associated with disgust. A major outstanding question is what that category might be.

Consistent with our focus throughout much of the article, we are primarily concerned with the cause of disgust toward pure moral transgressions. In particular, we will not consider sexual transgressions. As described briefly in the section on self-reports, evidence is beginning to emerge that the psychology of sexual transgressions, and perhaps of physically disgusting transgressions more broadly, is quite different from that of pure transgressions (Monin, Pizarro, & Beer, 2007; Young & Saxe, 2011).

A very small number of studies have examined what types of pure moral transgressions may be most strongly associated with disgust. As discussed previously, one of the earliest efforts in this vein was to link violations of autonomy with anger, community with contempt, and divinity with disgust (Rozin, Lowery, et al., 1999). However, positive results in this research may have been due to the self-report format that was used, and subsequent work using a different approach has not replicated these findings (Hutcherson & Gross, 2011). By contrast, more recent evidence (Cannon et al., 2011) suggests that transgressions of fairness norms may evoke stronger disgust than those involving harm, authority, or ingroup loyalty (cf. Graham et al., 2009). The specific role of disgust in regulating fairness is an important result that requires further systematic examination. Although harm represents a universal moral transgression (Turiel et al., 1987), fairness may be a product of cultural evolution, increasing in step with the need to purchase food (Henrich et al., 2010). This highlights the clear need for cross-cultural studies examining the existence of moral disgust and its antecedents. Last, the object of a transgression may also be important: Transgressions directed toward others, compared to the self, may elicit stronger disgust (Hutcherson & Gross, 2011). By contrast, transgressions directed toward the self may evoke relatively more anger, consistent with the idea that these situations pose a more immediate threat and thus warrant an active, approach-related response.

To our knowledge, these studies constitute the entirety of what is known about the specific types of pure transgressions that are most strongly associated with disgust. The results are suggestive, but much more work is needed before we can be certain of them. In what remains of this article, we therefore do not focus on the details of particular transgression types. Instead, we take a step back to consider a broader framework within which to understand what causes moral disgust. In doing so, we also hope to shed light on the relationship among distaste, physical disgust, and moral disgust.

We suggest that appraisal theory may provide a useful lens through which to view this issue. According to appraisal theorists, emotions are not caused directly by stimuli themselves but rather by the way that an individual evaluates or "appraises" a given stimulus in relation to his or her own goals and resources (Arnold, 1960; Lazarus, 1966). As such, different individuals can have different emotional reactions to the same stimulus, reflecting their distinct appraisal computations. Relatedly, distinct emotions such as disgust, anger, sadness, and so on are thought to result from the activation of a characteristic profile of appraisals, although the precise implementation differs across models (Roseman, 1984; Scherer, 1982; Smith & Ellsworth, 1985). These appraisals need not have a one-to-one mapping with emotion; that is, it is unlikely

that a single “fear” appraisal results in fear. Rather, appraisals may reflect a multidimensional space in which distinct emotions reside (Roseman, Antoniou, & Jose, 1996). The particular appraisals that trigger an emotion are closely tied to that emotion’s function, in that they should diagnose situations in which the emotion’s function is called for (Roseman & Smith, 2001). Applied to the current question, appraisal theory suggests that moral disgust may be triggered by a distinctive set of appraisals that serve to activate disgust in situations when it will be useful (e.g., perhaps when passive avoidance is the best course of action).

Note that appraisals can range from relatively simple and automatic to complex and effortful and that they may take place at different levels of the nervous system (Scherer, Schorr, & Johnstone, 2001). Importantly, we do not believe that appraisals must necessarily be “cognitive,” in the sense that they need not require conscious thought or high-level processing (Lazarus, 1991; Scherer et al., 2001). On this view, even distaste and physical disgust, which can sometimes seem to be almost reflexive responses to intrinsic stimulus properties, require some kind of antecedent appraisal or evaluation. For example, infants enter the world with a functioning distaste response to bitter stimuli, which is believed to defend against the consumption of potential toxins (Berridge, 2000; Steiner, 1973). Although one might argue from this that the aversiveness of bitter tastes is a property of the stimulus, it is not. Rather, it reflects a very basic form of information processing that distinguishes between things that are good and bad to eat. Although this primitive aversion to bitterness need not draw upon high-level inferences, it involves a computation of liking versus disliking (Zajonc, 1980).

Providing further evidence that distaste is mediated by appraisal, bitter tastes do not automatically trigger distaste in adults—if that were true, we would not like coffee, dark chocolate, or beer. The same is true of physical disgust stimuli. For example, rotten, stinking milk is sometimes cheese and may be appraised as delicious rather than disgusting. Additional support for the idea that physical disgust results from appraisal processes rather than reflex comes from the fact that at least some kinds of physical disgust are susceptible to reappraisal, (i.e., secondary, effortful changes in how a stimulus is evaluated; Ochsner & Gross, 2005). For example, participants who reappraised their responses to films showing amputations or burn victims reported lower levels of disgust than participants who passively watched the films (Gross, 1998). If physical disgust was a reflexive response to stimulus properties, such reappraisal should be difficult or impossible.

Given that disgust in general may result from appraisal processes, the question of what causes moral disgust and what differentiates it from other emotions becomes a question of what appraisal triggers are necessary to evoke moral disgust. As described, there is very limited evidence as to what specific appraisals might be important. In the next and final section of this article, we therefore ask more generally what kinds of appraisals could be involved and how they may be related to one another.

Common-, distinct-, and intersecting-appraisal models of moral disgust, physical disgust, and distaste. In an effort to synthesize the research on moral disgust that has been conducted to date and to organize further study of what causes moral disgust, we conclude by describing three potential models of moral disgust and its relationship to physical disgust and distaste. These models expand on several possibilities first suggested by Rozin, Haidt, and

Fincher (2009), in response to the claim that moral disgust is the same as or similar to physical disgust and distaste (Chapman et al., 2009). In all three models, we propose that some kind of evaluation or appraisal lies between the “raw” perception of a stimulus and the emotion that is eventually elicited. These appraisals can vary in complexity, and some may be quite primitive. We also assume that distaste, physical disgust, and moral disgust are each functional; that is, each serves a useful purpose in the behavioral repertoire by organizing an adaptive response to a challenge. Accordingly, the role of appraisals in each of the models is to determine whether a given stimulus calls for a disgust response.

The three models share the same basic three-layer architecture (see Figure 1). The top or input layer of the models represents objective stimuli in the world, including distaste stimuli such as a bitter quinine solution, physical disgust stimuli such as feces, and moral stimuli such as an unequal monetary offer in an economic game. In the bottom layer are disgust outputs, such as physiological changes, facial expressions, and other disgust-related behaviors (e.g., withdrawal tendencies). In between are appraisals or evaluations that link events to emotional outputs.

Where the models differ is in whether the same appraisals are associated with distaste, physical disgust, and moral disgust. Given evidence that moral disgust originates from physical disgust (Chapman et al., 2009; Rozin et al., 2000; Schaich Borg et al., 2008), the common-appraisal model (CAM; see Figure 1A) posits that physical stimuli such as feces as well as social stimuli such as inequality activate a common set of appraisals, which are in turn associated with a common output. Much more controversially (cf. Rozin et al., 2009), the appraisal calculus that applies to evaluating the palatability of foods (i.e., distaste appraisals) also applies to moral disgust. Note that although Figure 1A represents appraisal with a single circle, it is likely that more than one appraisal is necessary for disgust. In other words, the circle in Figure 1A represents a set of appraisals, not just one. The important point is that the same appraisal or appraisals are needed for distaste, physical disgust, and moral disgust.

At the other end of the spectrum, the distinct-appraisal model (DAM; see Figure 1B) posits that physical and moral disgust and distaste are each associated not only with a distinct set of stimulus triggers but also with a distinct set of appraisals. Once again, the individual circles representing appraisal could incorporate more than one appraisal process. The key idea is that new appraisals have become attached to a preexisting emotional output system (Rozin et al., 2000). This kind of change is not without precedent in the literature: for example, the physical pain system is thought to be the precursor of social pain, a response to rejection by or loss of valued conspecifics (MacDonald & Leary, 2005). On this model, the exaptation or co-option of distaste and physical disgust for moral disgust is restricted to the level of output systems and does not imply any similarity in underlying appraisals.

Finally, in the intersecting-appraisal model (IAM; see Figure 1C), the appraisals for distaste, physical disgust, and moral disgust are partially overlapping and partially distinct. Thus, for example, a moral stimulus such as an unequal monetary offer will trigger some appraisals that overlap with those triggered by feces (shown in red) and quinine (shown in blue), as well as moral disgust appraisals (shown in green) and appraisals that are unrelated to these kinds of stimuli (i.e., non-disgust-related moral appraisals; shown in gray). This model is different from the distinct-appraisal

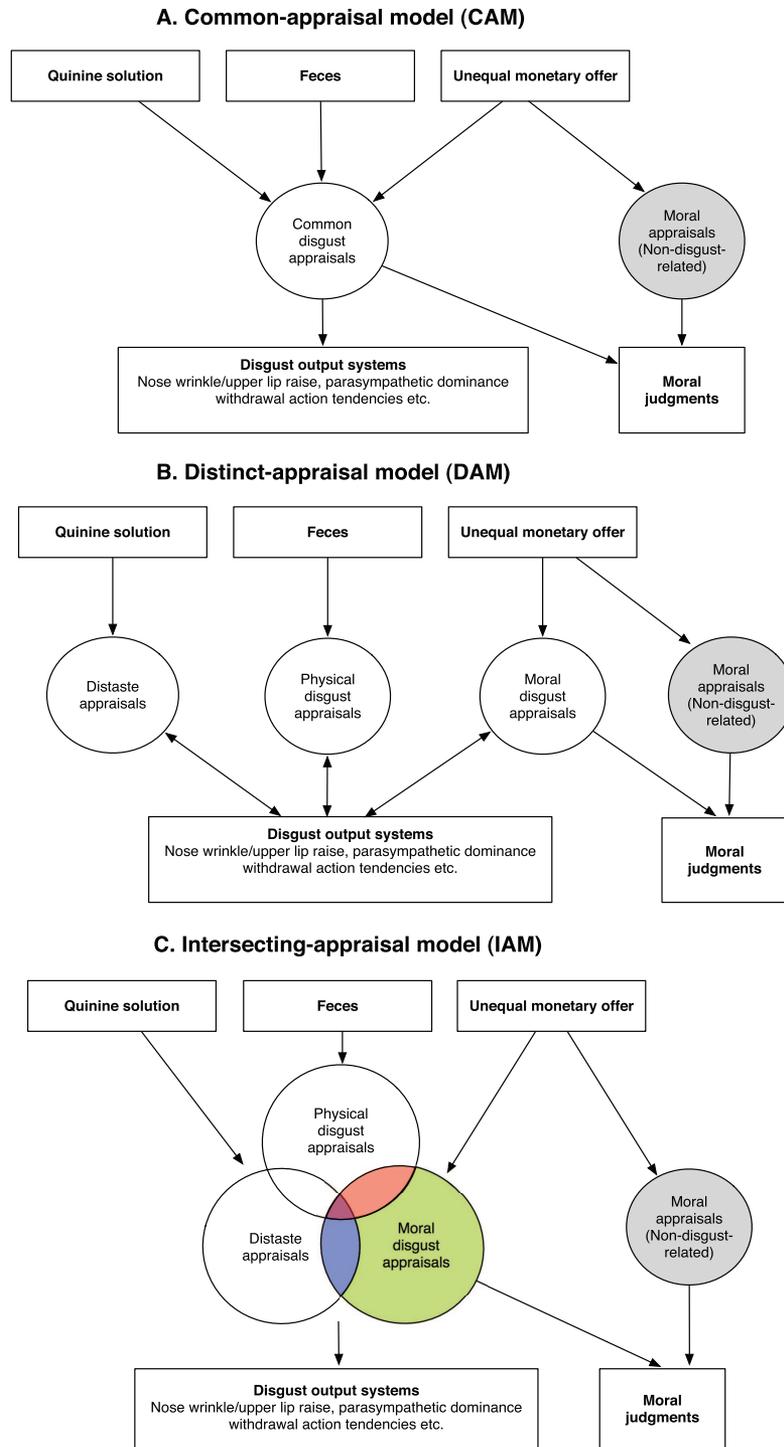


Figure 1. Three models of moral disgust and its relationship to physical disgust and distaste. In all three models, the top layer represents stimuli in the world that might trigger (from left to right) distaste, physical disgust, and moral disgust. The middle layer represents appraisals or evaluations, and the bottom layer represents disgust outputs. In the common-appraisal model (A), a shared set of appraisals links stimuli to outputs for distaste, physical disgust, and moral disgust. In the distinct-appraisal model (B), different appraisals are associated with distaste, physical disgust, and moral disgust. In the intersecting-appraisal model (C), the appraisals for distaste, physical disgust, and moral disgust are partially overlapping and partially distinct. Each model also shows how disgust-related appraisals may be related to moral judgment and indicates that judgment can also be triggered by appraisals that are unrelated to disgust.

model in that the similarity between moral disgust, physical disgust, and distaste is driven not only by a common output but also by a partially overlapping set of appraisals. From an evolutionary perspective, this means that some of the appraisal systems mediating the relationship between (disgust) stimulus and (disgust) response were co-opted or exapted into the social domain, in order to allow for moral disgust.

These models have contrasting implications for the issue of how similar physical and moral disgust are. In one sense, the degree to which two emotions are similar is related to the degree of overlap between their appraisals. Thus, physical and moral disgust are much more similar on the common- and intersecting-appraisal models than on the distinct-appraisal model. The models also differ in the degree to which they permit specialization at the output level. For the CAM, it is difficult to see how moral and physical disgust could result in distinct outputs (e.g., facial expressions), as there is one shared set of appraisals for all types of stimuli. In contrast, although the DAM and IAM models illustrated in Figure 1 show a single set of outputs for all kinds of disgust, these models could easily accommodate specialization on the output side, as different appraisals could be linked to partially distinct outputs.

So far we have not yet described how disgust is linked to moral judgments of right and wrong, good and bad, and so on. Dealing with this issue first requires addressing the question of how emotions—more broadly—are related to moral judgments. We take the stance that emotional outputs do not *constitute* moral judgments, at least not for pure moral transgressions that are free from physical disgust reminders (Huebner et al., 2009). That is, simply having a negative emotional response to a stimulus is not sufficient to judge it as morally wrong (Royzman, Leeman, & Baron, 2009). We base this position on the well-known influence of nonemotional factors on moral judgment (Chiu et al., 1997; Weiner, 2006). For example, an agent's negative intent is a key modulator of moral judgment: Hurting someone by accident is not nearly as wrong as hurting someone deliberately (Zelazo, Helwig, & Lau, 1996), even though an observer may have the same negative emotional reaction (i.e., output) to the harm that took place. Instead, we believe that appraisals are required for moral judgment, much as they are required for emotions. Accordingly, moral judgment is represented in our models as a distinct, independent output, consisting of a decision that something is morally right or wrong. Note that moral judgment is not an appraisal; rather, it is the consequence of appraisals. More than one appraisal may be necessary to decide that something is morally wrong; for example, it may be necessary to believe that someone tried to harm someone else and that the action was intentional and malicious (Weiner, 2006).

How can this view of moral judgment be combined with our models of disgust? In the CAM, the obvious solution is to posit that the very same appraisals that trigger distaste, physical disgust, and moral disgust also influence moral judgment (see Figure 1A). Note that disgust need not be the only route to moral judgment, as indicated by the path from the unequal offer, through non-disgust-related moral appraisals (shown in gray), to judgment. A strength of this model is that it makes explaining the influence of incidental distaste (Eskine et al., 2011) and physical disgust (e.g., Schnall, Haidt, et al., 2008) on moral judgment very easy. For example, drinking a bitter liquid would affect judgment by activating appraisals that are tied to moral judgment as well as disgust output.

The effects of individual differences in physical disgust sensitivity on moral judgment (Jones & Fitness, 2008) are also easily explained. Heightened physical disgust sensitivity may reflect a more sensitive common disgust appraisal, which would result in more severe judgment of transgressions via the link between disgust appraisals and moral judgments.

In considering the CAM, it is worth noting that merely having the neural prerequisites to appraise and reject a bitter taste as bad tasting, as in the infant brain, is insufficient for moral judgment. An infant enters the world with a facsimile of the adult response to strong bitter tastes but clearly not with the ability to make judgments about fairness. Thus, disgust-related appraisals alone cannot be sufficient for moral judgment in the CAM.

A limitation of the CAM is that the stimulus triggers for distaste, physical disgust, and moral disgust are very different. It is difficult to see how the same appraisals, presumably supported by the same neural mechanisms, could serve to evaluate each of them. Another limitation is that as mentioned, the CAM allows little room for differences between the different types of disgust in terms of outputs. As described, however, we know of differences between different disgusts, including neural and personality correlates, and time course.

In sum, we feel that the DAM and IAM are more plausible than the CAM. But how can these other models accommodate the influence of physical disgust on judgment? This question presents something of a challenge to the DAM. As shown in Figure 1B, we presume that it is the appraisals for moral disgust that are connected to moral judgment; once again, this need not be the only route to judgment. However, the moral disgust appraisals are distinct from the appraisals for physical disgust and distaste. Thus, activating distaste appraisals (e.g., with a bitter liquid) cannot directly affect moral judgment.

One possible solution relies upon the disgust output system, which distaste, physical disgust, and moral disgust have in common. In particular, bidirectional connections between appraisals and disgust output (as indicated by the double-headed arrows in Figure 1B) would allow for peripheral feedback to influence appraisals (Adelmann & Zajonc, 1989). Accordingly, activating the output system via one route (e.g., a bitter liquid) may cause other appraisals to resonate, including the moral disgust appraisals that are connected to moral judgment.

One implication of this model is that disgust output (i.e., motor and physiological responses) is a necessary prerequisite for distaste and physical disgust to influence moral judgment, similar to theories of embodied cognition (Niedenthal, 2007). Thus, a common output will be required for resonance between basic and higher level forms of disgust. The “resonance” version of the model may also generate the interesting and testable prediction that physically disgusting things should be viewed as immoral. Physical disgust stimuli activate the disgust output system, which should cause resonance in moral disgust appraisals, eventually triggering moral judgment. In this way, entering a public wash-room stall to find an unflushed toilet should be not only disgusting but also morally wrong.

Such resonance effects could potentially explain the phenomenon of “moral dumbfounding” that has been described for transgressions such as consensual incest (Haidt, 2001). Moral dumbfounding occurs when an individual cannot explain why he or she feels that a victimless but physically disgusting transgression is

wrong. On the DAM, this could occur if incest is primarily a physical disgust stimulus. As such, it would activate the disgust output system and eventually resonate through to moral judgment. Because bodily awareness appears to be an important modulator of incidental disgust effects on moral judgment (Schnall, Haidt, et al., 2008), this view predicts that attending to disgust output may be necessary for moral dumbfounding.

All this being said, the DAM does not require that moral disgust appraisals be sufficient for moral judgment or that the strength of feedback and feedforward connections must be symmetrical (Meier & Robinson, 2004). Thus, the prediction that physically disgusting things should be viewed as immoral is not critical to the model.

In contrast to the DAM, which requires feedback from output systems to accommodate the influence of distaste and physical disgust on moral judgment, the IAM suggests that such effects are due to direct activation of overlapping appraisals. For example, ingesting a quinine solution would activate distaste appraisals, including those that overlap with physical disgust and moral disgust. Because the latter are connected to moral judgment, ingesting a quinine solution could render moral judgments more severe, through commonality with moral disgust appraisals. Similarly, people who are more sensitive to physical disgust may have a physical disgust appraisal system that is more easily activated, including those appraisals that overlap with moral appraisals (shown in red in Figure 1C). The overlapping moral appraisals in turn are linked to moral judgments, so individuals higher in physical disgust sensitivity would also tend to make more severe moral judgments.

Both the DAM and IAM can accommodate known differences between types of disgust (e.g., in outputs, personality correlates), as well as the influence of incidental distaste and physical disgust and physical disgust sensitivity on moral judgment. Moral dumbfounding could also be explained within the IAM: Sexual disgust stimuli such as incest may activate appraisals that fall at the intersection of physical and moral disgust (shown in red in Figure 1C), thereby triggering moral judgment. As such, both models fit the existing data, and their result may be the same. Put somewhat differently, the exact implementation of the models may not be critical for appreciating their psychological function and effects.

Nonetheless, we can imagine empirical tests that may adjudicate between the two models. For example, feedback from the output stages is critical for the DAM, and thus manipulations that block this feedback, whether facial (Niedenthal, 2007; Oberman, Winkielman, & Ramachandran, 2007) or peripheral autonomic (Heims, Critchley, Dolan, Mathias, & Cipolotti, 2004), should reduce or eliminate the effect of incidental distaste and physical disgust on moral judgment.

Neuroimaging research may also help to assess the degree of overlap between the appraisals for distaste, physical disgust, and moral disgust. At present, it is unclear what activation in a particular brain region represents in terms of the underlying psychological processes (Poldrack, 2006). As highlighted previously, recruitment of a similar brain region in two separate tasks need not suggest that this activation represents the same computations, as many regions serve more than one role. However, recent methodological developments that identify multivariate patterns of regional activity afford a new window into the underlying neural population code (Mur, Bandettini, & Kriegeskorte, 2009; Norman,

Polyn, Detre, & Haxby, 2006). Such analyses allow an estimation of what information is represented in a particular brain region. It is at this level of neural response that theories about appraisal processes can ultimately be tested. To the degree that distaste or physical disgust appraisals are involved in moral disgust and moral judgment, the information contained in the neural population code for distaste and physical disgust should demonstrate significant, albeit partial, correspondence with moral disgust and judgment. Although this would not adjudicate between feedback resonance in the DAM and feedforward appraisals in the IAM, it could provide evidence for the activation of shared appraisals, regardless of their origin. To demonstrate specificity for disgust, such correspondence should not be found for other aversive states associated with withdrawal, such as sadness or fear. At present there is little work using a multivariate pattern analysis approach to examine emotional appraisals, but this method does provide a road map for how such questions can become more tractable and amenable to analysis at the neural level.

Summary and Conclusion

We have described a growing body of research that has investigated the role of disgust in moral cognition. Taken together, these studies converge to support the notion that disgust does play an important role in morality. We suggest that the time is now right to address more specific questions regarding the nature and role of disgust in moral cognition. In particular, the underlying appraisals that trigger moral disgust are almost entirely unknown, as is the precise relationship between moral and physical disgust. To provide a framework for these investigations, we have outlined three potential models of moral disgust, which differ in the degree to which common or distinct appraisals are responsible for physical and moral disgust.

The involvement of disgust in morality is consistent with an emerging view in which emotion is seen as a key component of moral cognition (Greene & Haidt, 2002; Monin et al., 2007). We do not subscribe to the view that distaste is sufficient for moral disgust—a sea anemone has the neural precursors of a disgust system (Garcia et al., 1975) but clearly this is not enough to support a complex emotional evaluation like moral disgust. Rather, we suggest that the commonality between physical and moral disgust illustrates the elegant pragmatism of brain design, whereby a new set of abstract social triggers is attached to an ancient motivational system originating in the rejection of aversive and potentially poisonous tastes. This co-option may have been driven by the association between disgust and withdrawal motivation, which could have been a valuable addition to the behavioral repertoire of our highly social species. Indeed, the involvement of disgust—with its ancient and critical adaptive function—in the moral sphere provides an indication of just how important the regulation of social behavior is for human beings.

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