Things Rank and Gross In Nature: Psychological, Physiological and Neuroimaging Investigations of Sociomoral Disgust

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy

Psychology

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Abstract

Much like unpalatable foods, filthy restrooms and bloody wounds, sociomoral transgressions are often described as “disgusting”. This linguistic similarity suggests that there is a link between sociomoral disgust and more rudimentary forms of disgust associated with toxicity and disease. Critics have argued, however, that such references are purely metaphorical, or that sociomoral disgust may be limited to transgressions that remind us of more basic disgust stimuli. My aim was to provide more direct evidence that sociomoral transgressions do genuinely evoke disgust, and to explore factors that may influence how much disgust is evoked. I first searched for similarity in the facial expressions evoked by gustatory distaste (elicited by unpleasant tastes), physical disgust (elicited by photographs of contaminants), and moral disgust (elicited by unfair treatment in an economic game). I found that all three states evoked activation of the levator labii muscle region of the face, characteristic of an oral-nasal rejection response and consistent with an origin of sociomoral disgust in oral disgust. I next investigated whether individual differences in the tendency to experience physical disgust are related to variability in sociomoral judgement and emotion. In two different populations, heightened sensitivity toward physical disgust was related to more severe sociomoral judgements. A complementary neuroimaging
study showed overlap between the neural correlates of physical disgust and sociomoral judgement, as well as highlighting brain regions that may underlie sociomoral hypersensitivity. Finally, I tested the idea that perceived differences in the causal stability of sociomoral transgressions may specifically affect levels of disgust. Although it was not possible to dissociate disgust from anger, the transgressions that were presented did evoke reliable self-reports of disgust. Taken together, these findings converge to support the conclusion that sociomoral transgressions can in fact elicit disgust, and accordingly that references to the disgusting nature of wrongdoing reflect biological reality rather than metaphor.
Acknowledgments

This research was made possible by the help and support of many people. First, my deepest gratitude to Adam Anderson, for being mentor, critic, therapist, inspiration and friend through all the ups and downs on the road to this dissertation. I have also benefitted greatly from the support and genuine interest of my committee members and many other faculty members in the department. Thanks to my lab brothers and sisters and cousins, and to everyone in my cohort, for advice, support, shared commiseration and lots of good times. I am especially grateful to the many undergraduate students and volunteers who have helped to collect the data for these and other studies conducted during my PhD. I hope you got something back too. Thanks to my family, to everyone at Massey College and to my stalwart friends, for everything.

And finally, thanks to Jordan, for always being there to help me carry heavy things over long portages.
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Chapter 1 Introduction

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 for himself and married Hamlet’s mother. Hamlet likens this state of affairs to an unweeded garden possessed completely by “things rank and gross in nature”. Although Shakespeare’s imagery is compelling, it remains unclear whether such references to the unsavory or distasteful nature of social and moral transgressions are metaphorical, or whether they might reflect a genuine experience of disgust. The studies presented here aim to address this issue, by investigating the role of disgust in morality. In particular, I ask whether the “disgust” elicited by social and moral transgressions is related to the disgust evoked by more concrete, physical stimuli, and if so, what features determine the level of disgust elicited by a given transgression.

1.1 Disgust: Origins and expansion

At first glance, disgust may seem to be an unlikely candidate for a social emotion. Disgust is thought to have originated in distaste, a food-rejection impulse triggered by the ingestion of unpleasant-tasting substances, prototypically those that are bitter (Rozin & Fallon, 1987; Chapman, Kim, Susskind, & Anderson, 2009). Since 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: sea anemones, which evolved approximately 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 is 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; Chapman et al., 2009). Disgust differs from distaste in being less closely tied to gustatory 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). While an individual 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 individuals (Rozin, Haidt, & McCauley, 2000). Collectively, I 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 & Biran, 2001; Curtis, Aunger, & Rabie, 2004; 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; Westermarck, 1891; Fessler & Navarrete, 2004). 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, 1975; Ekman & Friesen, 1978). These movements are associated with decreases in the exposed area of the eyes and closure of the nasal cavities, actions that may serve to reduce sensory intake and 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 (Rozin, Haidt, & McCauley, 1999). Physiologically, disgust appears to be associated with activation of the parasympathetic nervous system (e.g. slowed respiration, heart rate deceleration, reduced blood pressure, decreased skin conductance; Rozin, Haidt et al., 1999). These behavioral and physiological features of disgust are consistent with an origin in regulating ingestion and exposure to disease, and may complement the disgust facial expression in facilitating the rejection of disgusting stimuli.

Although physical disgust stimuli appear to be closely tied to disease and reduced long-term fitness, there is one category of disgusting stimuli that seems to lack this direct connection: individuals who violate social and moral norms (Rozin et al., 2000). For example, uncomplicated instances of theft, lying, and fraud all elicit reliable self-reports of disgust (Tybur, Lieberman, & Griskevicius, 2009). I refer to disgust elicited by such abstract transgressions as sociomoral.
disgust. The status of disgust as a sociomoral emotion has not gone unchallenged, however (Royzman & Sabini, 2001; Bloom, 2004; Oaten et al., 2009). Accordingly, I next review the existing evidence for disgust as a sociomoral emotion and consider its limitations. Before going on, however, I first clarify what I mean by the terms “sociomoral” and “sociomoral emotion”, and I briefly address the so-called emotion-reason debate in moral psychology.

1.2 A note on terminology and directionality

Prior to the early 2000’s, the majority of research on moral psychology was conducted by developmental researchers. One important contribution of this work was to establish that not all social rules are equivalent. In particular, the developmental research tradition differentiates between “moral” and “social-conventional” rules (Turiel, Killen, Helwig, Kagan, & Lamb, 1987; Smetana, 2006). Moral rules are seen by both adults and children as being independent of authority and existing social arrangements. Typically, the moral domain includes issues pertaining to rights, fairness and justice, and moral transgressions usually have intrinsic negative consequences to individuals. Unprovoked violence is a paradigmatic moral transgression: both adults and children report that it is always wrong, it should be wrong in all cultures, and it would be wrong even if it was not explicitly forbidden by law or custom (Turiel et al., 1987).

By contrast, social-conventional rules are understood to hold only within a particular cultural context and are dependent on authority or shared cultural understanding (Turiel et al., 1987; Smetana, 2006). Conventional rules serve to facilitate smooth social functioning, and other customs could substitute without negative effect. Rules of address, appropriate dress, and other “polite” social behaviours are typical examples of social conventions in the adult world. Violation of these rules only has negative consequences within a particular social context: for example, failure to shake hands upon being introduced to someone is problematic only in Western cultures. Note that even though social conventions are context-specific and depend on authority or social consensus, they need not necessarily be less important than moral rules: people can be deeply committed to social convention (Turiel, 2006). Moreover, the existence of distinct moral and conventional domains does not mean that people cannot make tradeoffs between them when they come into conflict, and morality need not always win out over convention (Turiel, 2006). In one study, for example, children were presented with stories in which the protagonist must choose between performing a minor moral transgression (stealing an
eraser) and a major conventional transgression (a boy going to school wearing a dress; Tisak & Turiel, 1988). When asked what the protagonist would *choose* to do, children selected the minor moral transgression because of the social disapproval associated with the conventional transgression. However, when asked what the protagonist *should* do, they selected the conventional transgression, because of the negative consequences to other individuals that would result from the moral transgression. In spite of this willingness to make tradeoffs between competing concerns, domain differences in reasoning and judgement were preserved: the minor moral transgression was seen as more independent of rules and authority than the major conventional transgression. Thus, the moral and conventional domains remained distinct even as children were able to coordinate priorities among them.

Beginning in the early 2000’s, a number of high-profile publications brought moral psychology to the attention of a wide spectrum of researchers outside of the developmental area (e.g., Greene, Sommerville, Nystrom, Darley, & Cohen, 2001; Haidt, 2001; Sanfey, Rilling, Aronson, Nystrom, & Cohen, 2003). Some of this recent work has aimed at expanding the definition of the moral domain to include concerns that would not be viewed as “moral” according to the definition just presented, such as traditions and concerns with physical purity (Haidt & Hersh, 2001; Graham, Haidt, & Nosek, 2009). Whether such an expansion is warranted is not the focus of the current research. However, I mention it in order to clarify that I will use the terms “moral” and “conventional” in the sense defined above. When I wish to refer to transgressions more broadly, including both the moral and social-conventional domains, I will use the term “sociomoral”.

The term “moral emotion” is also somewhat contested territory. Some researchers use it in a fairly restricted sense, to refer to a particular set of emotions that motivate appropriate sociomoral behaviour, especially empathy, guilt and shame (e.g. Tangney, Stuewig, & Mashek, 2007). I will use the term “sociomoral emotion” more broadly, to refer to any emotion that is evoked in the context of a sociomoral transgression. This broader definition includes emotions that may be evoked in response to sociomoral transgressions, such as disgust, anger and contempt, as well as feelings such as empathy, guilt and shame.

Another distinction that bears commenting upon is between sociomoral emotions and sociomoral judgements. I consider sociomoral judgements to be assessments of normative value, such as
right or wrong, good or bad. Although judgements are often correlated with emotions, they need not always be: for example, there is some evidence that psychopaths have normal sociomoral judgements but lack the corresponding emotions (Cima, Tonnaer, & Hauser, 2010). This point raises a final issue, namely the relationship between emotion and sociomoral judgement. In particular, some recent work has made the claim that sociomoral judgements are caused by fast, intuitive emotional responses (Haidt, 2001; Greene & Haidt, 2002). This stands in contrast to a more traditional view of morality, which places more emphasis on rational processes (Kohlberg, 1969; Turiel, 2006). Once again, this larger debate is beyond the scope of the present research. Issues of causal directionality are notoriously difficult to untangle, and the experiments that will be presented here are neither designed to nor capable of addressing the nature of the causal relationship between sociomoral emotions and judgements. Instead, I take the position that emotions are a highly salient aspect of sociomoral life, and hence are interesting objects of study whether they are causes or consequences of judgement. Emotions may also play an important role in motivating responses to sociomoral transgressions, a topic that I consider further in Chapter 4.

Having clarified these points, I now return to the main topic, namely the potential role of disgust as a sociomoral emotion.

1.3 Sociomoral disgust: Past evidence and limitations

1.3.1 Neuroimaging studies

Neuroimaging studies of morality and emotion have received considerable attention in recent years (e.g. Greene et al., 2001; Sanfey et al., 2003). I therefore begin by considering whether functional neuroimaging can shed light on disgust as a sociomoral emotion. A first question to ask is whether individuals who are exposed to sociomoral transgressions show neural activity that is consistent with the experience of disgust. The insula is often suggested as a neural marker of disgust, and indeed, this region is frequently activated when participants view disgusting photographs (e.g. Schienle et al., 2002; Wright, He, Shapira, Goodman, & Liu, 2004; Schienle, Schafer, Stark, Walter, & Vaitl, 2005b), disgusting videos (Harrison, Gray, Gianaros, & Critchley, 2010), or disgusted facial expressions (Phillips et al., 1997; Jabbi, Bastiaansen, & Keysers, 2008). 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 evidence 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 might lead one to believe that if insular activation were seen in response to sociomoral transgressions, it would be safe to infer that a subject is experiencing disgust. However, there are some limitations to this reasoning. The first is simply that the insula is a large region, consisting of five to seven gyri with considerable morphological variation across individuals (Craig, 2009). Therefore, one cannot assume that “insular” activation reported in two different studies (e.g., of physical disgust and sociomoral cognition) represents the same region. This problem can be addressed by examining both physical disgust and sociomoral cognition in the same experiment. In this case, formal statistical procedures exist to test for activation that is present in two experimental conditions presented to the same group of subjects (a “conjunction analysis”). To date, two studies of this type have been conducted (Moll et al., 2005; Borg, Lieberman, & Kiehl, 2008). In one experiment (Moll et al., 2005), participants passively read sentences describing disgusting actions (e.g. seeing a cat eating feces), sociomoral transgressions 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). Disgusting actions and sociomoral transgressions commonly activated frontal regions including medial and lateral orbitofrontal cortex, as well as superior and inferior frontal gyri and inferior temporal gyrus. However, interpretation of these findings is complicated by the fact that many of the sociomoral transgression stimuli used in this study also contained reminders of physical disgust (e.g. seeing a cockroach in a restaurant). Thus, this study does not provide a pure comparison of physical and sociomoral disgust. Moreover, the authors failed to distinguish between moral and conventional transgressions when constructing their “indignation” stimuli, a problem that is common in neuroimaging studies of morality (Killen & Smetana, 2008; Carpendale, Sokol, & Miiller, 2010; Turiel, 2010). Indeed, one of the example stimuli given to illustrate this category—seeing a cockroach in the washroom of a restaurant—could be viewed as either a moral or a conventional transgression, or perhaps simply as an accident or oversight, depending on individual interpretation. It is thus unclear whether the neural overlap between
physical disgust and “indignation” reflects neural processes shared with morality, convention, both, or neither.

A more recent study (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 that did not involve physical disgust stimuli (e.g. murder, theft), with neutral actions for comparison. Again, little information was given about how stimuli in the “moral” category were constructed; the examples given suggest that they may be straightforward moral transgressions, but without further information it is difficult to tell. The task was for subjects to memorize the sentences, with a new/old recognition test later in each block.

An analysis that examined common activations for pathogen disgust, incest disgust and moral transgressions found large areas of overlapping activation, including frontal areas similar to those observed in the Moll and colleagues (2005) study, as well as amygdala, anterior cingulate, basal ganglia and temporal regions. Although these results suggest that at least some common neural processes underlie both physical disgust and sociomoral transgressions, it remains unclear whether higher-levels forms of disgust consistently engage the most primitive forms of disgust putatively supported by anterior insular gustatory cortex. No study has examined whether gustatory cortical representations of distaste are related to more abstract forms of disgust.

A second limitation to the use of neuroimaging to search for sociomoral disgust is that even if insular activation were to be observed in the same experiment in response to both physical disgust and sociomoral transgressions, some caution would still be warranted in inferring that participants experienced disgust in response to the transgressions. In particular, this inference depends on the assumption that the insula is selective for disgust. However, the insula is also engaged by a number of other 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), and perceptual decision-making (Binder, Liebenthal, Possing, Medler, & Ward, 2004; for review see Craig, 2009). This lack of selectivity for disgust is an example of the “reverse inference” problem in neuroimaging (Poldrack, 2006). A reverse inference is made when a researcher infers the presence of a particular cognitive process from brain activation in a
particular region, and its validity depends on the selectivity of the brain region for that process. Since the insula is not highly selective for disgust, we cannot be certain that activation in this region reflects the experience of disgust. The existence of the reverse inference problem does not mean that no useful information can be gained from neuroimaging; rather, it suggests that cognitive processes should be inferred tentatively, and it highlights the importance of converging evidence from behavioural and psychophysiological measures.

1.3.2 Behavioural studies: Are sociomoral transgressions really disgusting?

Given the difficulty of inferring the presence of a specific emotion from neuroimaging data (Poldrack, 2006), I now consider what has been learned from more traditional behavioural studies. The most straightforward behavioural approach has been to vary the sociomoral content of a stimulus and then measure how much disgust ensues. Most directly, researchers simply present a transgression and ask participants to provide a verbal rating of how disgusting they find the stimulus. Indeed, participants self-report disgust to transgressions presented both in written form (Tybur et al., 2009) and as photographs (Simpson, Carter, and Anthony, & Overton, 2006). However, a limitation of verbal self-report is that the word “disgusting” is also used in colloquial English to refer to angering or irritating situations (Nabi, 2002). Thus, verbal self-reports of disgust cannot distinguish clearly between disgust and other emotions such as anger that may be experienced in response to sociomoral transgressions.

Another approach has been to use more implicit measures to determine whether disgust is elicited by sociomoral transgressions. For example, participants who read vignettes describing criminals completed more disgust- and washing-related word stems than those who read vignettes describing neutral situations (Jones & Fitness, 2008). On the behavioural side, participants who recalled a sociomoral transgression that they had committed were more likely to choose an antiseptic wipe as a gift than those who recalled a prosocial act (Zhong & Liljenquist, 2006). Once again, however, the specificity of these implicit measures to disgust is uncertain: it could be that any negative emotion might lead to these effects.

A more experimental method has been to evoke disgust through various manipulations, then look for changes in sociomoral judgement. In an early study of this type, highly susceptible participants were placed under a post-hypnotic suggestion to feel “a pang of disgust…a
sickening feeling in [the] stomach” upon encountering a neutral trigger word (Wheatley & Haidt, 2005). The trigger word was then embedded in vignettes describing sociomoral transgressions. Participants who read vignettes containing the trigger word reported experiencing more disgust, and also judged the transgressions to be more wrong, than participants who read the same vignettes without the trigger word. The disgust manipulation did not affect non-sociomoral judgements (e.g., general feelings about objects in the story). Thus, evoked disgust appears to specifically affect sociomoral judgements, rather than rendering all kinds of evaluations more negative. Importantly, however, no comparison emotion was examined, so similar to the implicit measures, it could be that induction of any negative emotion might bias moral judgement.

A more recent study aimed to replicate and extend this study by using a variety of more conventional disgust elicitors, including exposure to unpleasant odors, a dirty room, recall of disgusting events and viewing a disgusting film (Schnall, Haidt, Clore, & Jordan, 2008). Judgements were indeed more severe in the disgusting condition, although the effect of disgust on sociomoral judgement was modulated by individual differences in sensitivity to bodily states. Specifically, the disgust manipulation only affected sociomoral judgement 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). In other words, individuals who were more aware of their body were more likely to be swayed by extraneously induced disgust. This study also made an effort to show that it is disgust specifically, and not just any negative emotion, that affects sociomoral cognition. In particular, participants who viewed a sad film clip did not make more severe sociomoral judgements (Schnall, Haidt et al., 2008). A limitation of this control is that the disgusting film elicited much stronger reports of disgust (mean of 11.4 on a 21-point scale) than the sad film elicited reports of sadness (mean of 4.72). Accordingly, a non-specific intensity effect cannot be ruled out.

The two experiments just described both tested the hypothesis that increased disgust should increase the severity of sociomoral judgements. The inverse prediction is that reduced disgust should decrease the severity of sociomoral judgements. While this exact prediction has not been tested, a related one has: namely, that physical cleansing should also render sociomoral judgements less severe (Schnall, Benton, & Harvey, 2008). A caveat is that these two hypotheses may not be synonymous, since cleansing could decrease other negative emotions besides disgust, or even increase positive emotions. Whatever the true mechanism, cleansing does appear to
affect sociomoral judgement. Participants who unscrambled cleansing-related words or who washed their hands after viewing a disgusting film subsequently rated sociomoral transgressions as less wrong than participants in a control group (Schnall, Benton et al., 2008). These results suggest that notions of physical cleanliness—the conceptual opposite of disgust—may be associated with sociomoral judgement.

A final approach has taken advantages of individual differences in the tendency to experience disgust toward physical stimuli. If disgust is indeed a component of the emotional reaction to sociomoral transgressions, then individual differences in physical disgust sensitivity may be associated with differences in sociomoral judgements or morally-charged social orientations. Trait disgust, or disgust sensitivity, is most commonly assessed using all or part of the Disgust Scale (DS), a 32-item self-report questionnaire (Haidt, McCauley, & Rozin, 1994). The DS measures an individual’s tendency to experience disgust towards a variety of stimuli, including spoiled foods, body products such as feces and vomit, contact with death, blood and gore, minority or unusual 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 sociomoral judgements. Put somewhat differently, there is no obvious reason why an individual’s response to seeing a cockroach should be related to how they judge a sociomoral transgression. Of course, the correlational nature of individual differences studies is always a concern. In particular, third variables may be present, given the known associations between the DS and personality characteristics including neuroticism and sensation seeking, with which it is positively and negatively correlated, respectively (Haidt et al., 1994). Some studies have made efforts to rule out potential effects of third variables, as will be described.

To begin, variation in physical disgust sensitivity has been linked with attitudes toward crime and criminals. Subjects who scored higher on a shortened version of the DS were more likely to vote “guilty” after reading a fictional transcript of a murder trial (Jones & Fitness, 2008). In contrast to the physical disgust sensitivity effect, differences in trait anger did not influence verdicts. In another experiment, subjects 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. Trait anxiety did not predict these effects.
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). Beyond these general orientations, 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, gun control etc. (Inbar et al., 2009). Of the ten 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 disgust.

A final individual differences study using the DS has examined the relationship between disgust and attitudes toward outgroups (Hodson & Costello, 2007). Individuals higher in interpersonal disgust—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.

While Haidt and colleagues’ (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 moral transgressions such as cheating and stealing ("moral disgust"; Tybur et al., 2009). Across four different samples, 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 while the different types of disgust are related, they are not identical, and indeed, each showed a different relationship with variables such as sex and big-five personality characteristics.

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1 Given that other researchers have found an association between disgust sensitivity and attitudes toward criminals (Jones & Fitness, 2008), this specificity to gay marriage and abortion may appear somewhat surprising at first glance. However, crime was not among the issues examined by the study of specific attitudes (Inbar et al., 2009), so the two findings are not necessarily contradictory.
In summary, the existing literature provides some preliminary evidence that disgust may function as a sociomoral emotion. However, specificity to disgust is a recurring issue. For studies that attempted to measure disgust elicited by sociomoral transgressions, it has been a challenge to find measures that specifically index disgust, rather than other negative emotions. For studies that have tried to examine whether experimentally induced disgust affects sociomoral judgement, it is necessary to demonstrate that the observed effects are specific to disgust; that is, appropriate control conditions are necessary to ensure that induction of other emotions would not produce the same results. Only limited efforts to this end have been made. Finally, for individual differences studies, the challenge is to show that effects of physical disgust sensitivity are not due to other personality or affective variables with which disgust is correlated. While some studies have done so (Hodson & Costello, 2007; Jones & Fitness, 2008), others have not (Inbar et al., 2009).

1.3.3 Behavioural studies: What kinds of transgressions are disgusting?

The studies reviewed in the previous section have all addressed a fairly broad question, namely whether disgust is involved at all in sociomoral emotion and judgement. A more focused question that has received much less attention is whether there are specific kinds of transgressions that might be especially likely to elicit disgust. One intuitive position is that sociomoral disgust might be reserved for transgressions that contain direct reminders of physical disgust, such as gruesome murders or crimes involving a sexual perversion (Bloom, 2004; Oaten et al., 2009). However, although physical disgust reminders can result in increased disgust in a sociomoral context (Gutierrez & Giner-Sorolla, 2007), it does not seem that such reminders are necessary for sociomoral disgust. Many of the studies discussed above used stimuli that did not contain physical disgust reminders, and still found evidence of increased disgust in response to transgressions (Zhong & Liljenquist, 2006; Jones & Fitness, 2008; Danovitch & Bloom, 2009), more severe moral judgements in response to evoked disgust (Wheatley & Haidt, 2005; Schnall, Haidt et al., 2008), and associations between disgust sensitivity and sociomoral cognition (Hodson & Costello, 2007; Jones & Fitness, 2008; Tybur et al., 2009).

A variant of the position that physical disgust reminders are necessary for sociomoral disgust is that only transgressions that are conceptually related to physical disgust can trigger sociomoral disgust (Rozin, Lowery, Imada, & Haidt, 1999). Specifically, it has been proposed that
transgressions that violate notions of spiritual purity or sanctity may be especially likely to evoke disgust (Rozin, Lowery et al., 1999). This position draws on an alternative conceptualization of morality proposed by Shweder and his colleagues (Shweder et al., 1997). Unlike the developmental cognitive perspective, which divides the world of social rules into moral and conventional domains, these authors propose that the moral sphere consists of three moral codes or ethics: the “ethic of divinity”, concerned with the sacredness of God and the purity or degradation of the self and others; the “ethic of community”, concerned with duty and hierarchy, and the “ethic of autonomy”, concerned with individual rights and freedoms (Shweder et al., 1997). Note that while the ethic of autonomy maps fairly straightforwardly onto the moral domain from the developmental cognitive perspective, the other two ethics may pertain to a mixture of moral and conventional issues depending on how the individual interprets the particular issue at hand. For example, religious rules about appropriate dress—most likely part of the ethic of divinity or community according to Shweder’s model—may be viewed as a moral issue if failure to follow them could result in harm to the spirit of a deceased ancestor (Turiel et al., 1987), or as a conventional issue if there are no such concerns (Nucci, 1986).

The validity of Shweder and colleagues’ view is a subject of debate (see e.g. Turiel et al., 1987) that is beyond the scope of this thesis. However, more directly relevant is that an effort has been made to tie Shweder and colleagues’ view of morality to emotions. It has been proposed that each moral code may be linked to a different emotion: anger might be most closely associated with violations of the ethic of autonomy; contempt with violations of the ethic of community; and disgust with violations of the ethic of divinity (Rozin, Lowery et al., 1999). Unfortunately, the materials that were used to test the disgust-divinity connection almost all described physical disgust stimuli (e.g., eating rotten meat; Rozin, Lowery et al., 1999). It is therefore not surprising that they evoke disgust, but it is unclear whether this disgust is related to the moral violation or the physical disgust stimulus.

To the best of my knowledge, this short discussion summarizes what is known about the kinds of transgressions that evoke disgust. Beyond the rather general point that direct reminders of physical disgust do not seem to be necessary for sociomoral disgust, the question remains wide open. In particular, while disgust in relation to Shweder’s three ethics has been touched upon, there has been no research on whether disgust might be more closely tied to the moral or social conventional domains described by the developmental cognitive research tradition.
1.4 Summary and outline of studies

The review just completed illustrates that the existing evidence for disgust as a sociomoral emotion is limited at best, and that next to nothing is known about what types of transgressions most strongly elicit disgust. The aim of the studies presented here is to address these issues by providing a stronger test of the role of disgust in morality and social convention. Chapter 2 examines disgust as a sociomoral emotion by comparing the facial expressions evoked in response to physical disgust stimuli and in response to moral transgressions. Chapter 3 adopts an individual differences approach, examining whether normal and pathological variation in the tendency to experience physical disgust predicts differences in sociomoral judgement, when controlling for differences other trait emotions. Chapter 3 also uses neuroimaging to directly compare and contrast the neural substrates of physical disgust and sociomoral judgement, taking into account the distinction between moral and conventional transgressions. The goal of Chapter 4 is to provide a more detailed analysis of factors that may influence the amount of disgust elicited by a sociomoral transgression. Finally, Chapter 5 summarizes the thesis.
Chapter 2  Facial EMG Responses to Physical and Sociomoral Disgust

As described in the introduction, a challenge for previous studies that have attempted to measure sociomoral disgust has been to identify measures that specifically index disgust. Neuroimaging research, although very informative in other ways, has not yet revealed a specific neural signature of the experience of disgust (Poldrack, 2006). Verbal self-reports can also be problematic, since the word “disgusting” is used by English speakers to refer to angering or irritating situations as well as disgusting ones (Nabi, 2002). The goal of the experiments presented in this chapter was to use a more specific measure to examine whether sociomoral transgressions evoke disgust. To that end, I made use of facial expressions to examine the relationship between physical and sociomoral disgust.

Recent work supports Darwin’s thesis (Darwin, 1872/1998) that the configuration of emotional facial expressions has evolved from a functional role in regulating sensory intake (Susskind et al., 2008). For example, wide eyes in the fear expression serve to expand the visual field, which may in turn enhance visual perception in threatening environments (Susskind et al., 2008). Such functional configurations may later have proven useful as social signals, assuming a new role without needing to change their basic form (Darwin, 1872/1998; Susskind et al., 2008). Consequently, if sociomoral disgust really is born from the same emotion involved in rejection of hazardous foods, then there should be continuity in facial actions between sociomoral and oral disgust, despite the former being far removed from its purported origin in food rejection.

To assess facial motor actions objectively, I employed facial electromyography (EMG). This technique was selected because EMG allows for greater sensitivity in detection of facial motor activity than visual scoring techniques (Tassinary, Cacioppo, Cacioppo, Tassinary, & Berntson, 2000), since sociomoral disgust might result in subtle overt facial movements originating from the residual engagement of a primitive oral disgust motor program. I focused on EMG activation of the *levator labii* muscle region of the face, which raises the upper lip and wrinkles the nose.

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These movements are thought to be characteristic of the facial expression of disgust (Ekman, Friesen, & Ancoli, 1980; Vrana, 1993), and may aid in the function of oral-nasal rejection of aversive chemosensory stimuli (Susskind et al., 2008). In each of the studies presented, I included control conditions to ensure that *levator labii* activation was specifically associated with disgust. In Experiment 1, I examined EMG responses to distasteful gustatory stimuli. Experiment 2 then examined responses to physical disgust. Finally, Experiment 3 examined whether the pattern of EMG results observed in the first two experiments would obtain for sociomoral transgressions.

### 2.1 Experiment 1

My first goal was to collect objective measurements of the physical disgust expression, with which to compare expressions of sociomoral disgust. As discussed above, the most primitive manifestation of disgust is thought to be distaste. However, little is known about spontaneous expressions elicited by distaste in adults and their underlying facial motor activity. Therefore, Experiment 1 measured facial EMG associated with distaste by having participants ingest unpleasant-tasting bitter, salty and sour liquids. A sweet solution of approximately equivalent subjective intensity to the unpleasant solutions was used as a control for non-specific effects of gustatory stimulation, while water was used as a neutral control.

#### Participants

Twenty-seven healthy adults (19 female) participated in the study for course credit or $20. All procedures in this and subsequent experiments were approved by the Research Ethics Board at the University of Toronto, and participants gave informed consent prior to beginning the studies.

#### EMG apparatus

EMG data were acquired using a BIOPAC MP-150 system. At acquisition, data were amplified ($\times 1000$) and filtered with a bandpass of 100-500 Hz. Electrodes were placed over the *levator labii* muscle region on the left side of the face, using the placements suggested by (Tassinary et al., 2000).

#### Chemosensory stimuli
Solutions of quinine sulfate (ranging from $1.0 \times 10^{-3}$ to $1.0 \times 10^{-5}$M), sodium chloride ($5.6 \times 10^{-1}$ – $1.0 \times 10^{-1}$M), citric acid ($1.0 \times 10^{-1}$ – $1.8 \times 10^{-3}$M) and sucrose (1.0 – 0.18M) were used as bitter, salty, sour and sweet stimuli respectively. Tastant concentrations were selected individually for each participant by having participants sample and rate the intensity and valence of 5 concentrations of the bitter and sour solutions (which were most aversive, as indicated by pilot testing) and 4 concentrations of the salty and sweet solutions. Tastants were presented in small cups, with a sample size of 2ml. Valence and intensity were rated on 11-point scales, relative to tap water: participants were instructed to assume that water has zero intensity and neutral valence. After all the solutions were rated, the experimenter reviewed the participant’s responses and selected bitter, salty and sour concentrations with ratings close to “very unpleasant”. Sucrose concentrations were selected so as to be approximately equivalent in perceived intensity to the other solutions (“strong” intensity).

Procedure

Following the rating procedure, the experimenter applied the EMG electrodes, set up the sample cups for the first block of the experiment, and left the testing booth. The experiment was divided into five blocks, one each for water and the bitter, sweet, salty, and sour solutions. Because the taste of quinine persists in the mouth for an extended period, the bitter block was always presented last, while the other tastants were presented in counterbalanced order. Blocks consisted of five taste trials in which participants sampled 2ml of the appropriate liquid. To control the timing of each trial, written instructions were presented on a computer monitor using E-Prime experimental software. Trials began with a 20s baseline period during which participants rested quietly. Next came an 8s period when participants grasped the first sample cup and brought it to their lips. This was followed by 8s during which participants sipped the contents of the sample cup, swished the liquid twice in their mouth and held the liquid in their mouth without swallowing. Participants next swallowed the liquid, and after a further 8s, rinsed their mouths with ~10ml of water, swallowing when finished. Finally, participants rated the valence and intensity of the preceding sample using the scales described above. After participants completed all five trials of a block, the experimenter entered the booth to arrange the sample cups for the next block.

EMG analysis
EMG data were analyzed using custom software written in MATLAB Version 7. A 30 Hz high-pass filter was applied to the EMG data to reduce low-frequency noise. The signal was then rectified with an absolute value function and smoothed with a 10 ms window. The period of interest in each trial was the 8s of the “swallow” phase, which is least likely to be contaminated by extraneous muscle activation due to sipping. Signal from the final 8s of the preceding baseline period was used to calculate signal change during the swallow phase. A contour following integrator was then applied to compute a running sum of sample values. The final value of the sum at the end of each swallow period was used for statistical analysis.

Statistics and data analysis

Because the focus of the current research is on comparing distasteful to pleasant stimuli, the three unpleasant stimuli (bitter, sour and salty) were averaged together for comparison against the sweet and neutral stimuli. To compute correlations, the EMG/self-report pairs for all 25 trials were rank-ordered by decreasing valence for each participant. As is common practice in the EMG literature (Lang, Greenwald, Bradley, & Hamm, 1993; Larsen, Norris, & Cacioppo, 2003), the EMG responses at each rank were then averaged across participants, and the average values were correlated with valence rank.

Results and discussion

As shown in Figure 1A, consistent with the origin of disgust in distaste, drinking the unpleasant solutions resulted in activation of the levator labii region, relative to drinking water and the sweet solution (F[2,52] = 8.07, p < 0.01). More specifically, levator labii region activity was greater for unpleasant solutions relative to the sweet solution (t[26] = 2.89, p < 0.01). Levator labii region activity did not reflect a nonspecific response to intense tastes, as the pleasant sweet solution did not evoke significant activity relative to neutral water (t < 1). Figure 1B shows that participant ratings of unpleasantness were highly correlated with the strength of levator labii region activity (linear r = .77, p < 0.001; quadratic r = .93, p < 0.001). The stronger quadratic relationship could indicate that levator labii activation is characterized by a threshold effect: that is, activation of this muscle region may be most responsive to the most aversive stimuli. In sum, levator labii activation appears to provide a specific index of gustatory distaste.
Figure 1. (A) Mean levator labii activation in response to the gustatory stimuli in Experiment 1. Error bars give +1 SEM. (B) Correlation between valence ratings and EMG. Linear (solid line) and quadratic (dashed line) fits are shown.

2.2 Experiment 2

In the next experiment, I moved beyond simple gustatory stimuli to examine the facial movements associated with more conceptual, but still relatively concrete forms of disgust. *Levator labii* region EMG was recorded while participants viewed photographs of uncleanliness and contamination-related disgust stimuli, including feces, injuries, insects, etc. Sad photographs of equivalent negativity were used as a control for non-specific effects of negative emotional arousal, and neutral photographs were also presented.

Participants

Nineteen healthy adults participated in this experiment. EMG data from one participant were eliminated for technical reasons, for a final sample size of 18 (8 female).

Stimuli

Twenty disgusting and twenty sad photographs were chosen from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) in a two-step selection process. In the first step, published emotional category ratings (Mikels et al., 2005) were used to identify disgusting photographs that were rated as high in disgust but low in sadness, as well as sad
photographs that were high in sadness but low in disgust. A group of 20 neutral photographs low in both sadness and disgust was also selected.

In the second step, ratings from the IAPS norms were used to match the sad and disgusting photographs on mean valence. The final set of 20 disgusting photographs was largely composed of images of contamination and uncleanliness, such as body products, body envelope violations, and insects. The 20 sad photographs included (among others) homeless persons, traffic accidents, and distraught or ill individuals (illness photographs did not involve overt injury or mutilation, contagious disease or body products). Neutral photographs included household objects, outdoor scenes and abstract images.

Procedure

The experimenter first applied the EMG electrodes and left the room. The 60 photographs were then presented once in random order. Each trial began with a 6s baseline period during which participants viewed a fixation cross, followed by 6s of image presentation. Participants then rated the preceding image on sadness and disgust, using 9-point scales, before continuing to the next photograph.

EMG analysis

EMG data were processed largely as in Experiment 1. The period of interest in each trial was the 6s image presentation period. Signal from the 6s of fixation preceding each image was used as a baseline to calculate signal change scores.

Statistics

The correlations between levator labii region EMG and disgust/sadness ratings were computed similarly to Experiment 1. Disgust and sadness ratings for all 60 photographs were rank-ordered for each participant, in order of increasing disgust or sadness. The paired levator labii region responses at each rank were then averaged across participants, and these values were correlated with rank.
Results and Discussion

Figure 2A shows that only the disgusting photographs resulted in increased activation of the levator labii region (F[2,34] = 8.58, p < 0.001). Disgusting photographs resulted in significantly greater levator labii region activity than sad photographs (t[17] = 3.71, p < 0.01), while sad photographs did not differ from neutral photographs (t < 1). Subjective ratings of disgust for each photograph were significantly correlated with activation of the levator labii region: the stronger the self-reported experience of disgust in response to the photograph, the more levator labii region activity was evoked (Figure 2B; r = 0.52, p < 0.001). The more significant quadratic trend (r = .80 p < 0.001) suggests that similar to the gustatory stimuli, the levator labii region may be most responsive to strong levels of physical disgust. In contrast to the disgust ratings, sadness ratings did not predict levator labii region activity (Figure 2C; r = 0.19, p = 0.15). Since negative emotional arousal associated with increasing sadness did not correlate with activation of the levator labii region, facial motor activity in this area is not a general response to aversive experience (Ekman et al., 1980; Vrana, 1993). These results indicate that more abstract and complex—but still non-sociomoral—forms of disgust evoke facial motor activity that is very similar to that evoked by unpleasant tastes.

Figure 2. (A) Mean levator labii region EMG evoked by viewing neutral, sad and disgusting photographs in Experiment 2. Error bars are +1 SEM, calculated within-subjects (Loftus & Masson, 1994). (B) Correlation between disgust ratings and levator labii region EMG. Linear (solid line) and quadratic (dashed line) fits are shown. (C) Correlation between sadness ratings and levator labii region EMG, showing linear fit.
2.3 Experiment 3

Having determined that both the primitive distaste response and more complex forms of physical
disgust evoke *levator labii* region activity that is proportional to the degree of disgust or distaste
experienced, I next examined whether the same pattern of results would obtain for moral
transgressions. Given that fairness is a cornerstone of human morality and sociality (Henrich et
al., 2004), I examined the facial motor activity associated with violations of the norm of fairness,
using the Ultimatum Game (UG) as a model of unfairness in social interactions. In my version of
the UG, two players split $10: the proposer suggests how the money should be split (an “offer”),
which the responder can accept or reject. If the responder accepts, the money is split as proposed;
if he or she rejects the offer, neither player receives anything. Participants in this experiment
played the UG in the role of responder. Previous work has shown that offers which are strongly
skewed in favour of the proposer are likely to be rejected e.g. (Guth, Schmittberger, & Schwarze,
1982). From a purely financial perspective, this behaviour is counterintuitive, since receiving a
small amount of money should be better than receiving no money. However, human beings are
strongly motivated by social as well as financial concerns. Indeed, participants report that
unequal offers are unfair (Pillutla & Murnighan, 1996), suggesting that a motivation to punish
the other player for this unfair behaviour may contribute to the rejection of unequal offers
(Rabin, 1993; Falk & Fischbacher, 2006).

**Participants**

Twenty-one healthy volunteers participated in this study. Five participants were disqualified
because debriefing revealed that they had suspected the deception involved in the experiment.
The final sample size was 16 (11 female).

**EMG acquisition**

EMG data were acquired as in the previous experiments.

**Procedure**

Participants were tested in groups of 2-3, with each participant seated in a private booth. The
experimenter first explained the nature and rules of the UG, and informed participants that they
would always play the role of responder. Participants were next introduced to a group of 10
proposers (confederates) seated at computer terminals in two adjoining rooms. All players were told that they would be paid according to their choices in the game. Participants returned to the testing room and the EMG electrodes were applied.

In the UG, each participant played 20 rounds of the game, one with each of the 10 confederates and 10 with an avowed computer partner (as a manipulation of sociality). In reality, all offers were generated by a computer algorithm so as to control the size and number of offers made. Rounds were presented in random order. The 10 offers from the computer partner were identical to those from the human partners, and mimicked the range and distribution of offers made in uncontrolled versions of the game, in which actual human proposers make offers (Guth et al., 1982): 50% “fair” ($5:$5) offers, 20% $9:$1 offers, 20% $8:$2 offers and 10% $7:$3 offers. No $6:$4 offers were presented, as we were primarily interested in exploring the response to offer that were more strongly unfair.

Each UG round began with a 6s waiting period followed by 6s of fixation. The participant then saw the photograph and name of their partner in that round for 6s. Next, participants saw the offer proposed by their partner for 6s, after which came a 6s window during which they indicated whether they accepted or rejected the offer by pressing one of two keys on the keyboard. To reinforce the social nature of the interaction, names and photographs of proposers remained visible throughout the offer and decision phases.

After seeing the trial’s outcome displayed for 6s, participants rated, on a 1-7 scale, how well their feelings about the preceding offer were represented by a reliably recognized facial expression of a universal emotion (Matsumoto & Ekman, 1988). The seven emotion rating slides (happiness, sadness, anger, fear, disgust, surprise, contempt) that followed each offer were presented in random order. Finally, participants were debriefed and paid for their participation according to their choices in the games.

**EMG analysis**

Using the same custom software, EMG data were first filtered with a 55-65Hz notch filter and then with a 30Hz high-pass filter, before rectifying and smoothing as above. We analyzed the 6s period during which the proposer’s fair or unfair offer was revealed; recordings from 6s before
the onset of the offer display (i.e., during the partner display) were used as a baseline from which to calculate signal change scores. Lastly, a contour following integrator was applied.

Statistics and data analyses

Preliminary analyses revealed only a few small differences between responses to human vs. computer partners. Results presented here thus give combined data from all 20 trials.

The correlations between disgust, anger, sadness and contempt endorsement and levator labii region EMG were computed similarly to the previous experiments. Emotion ratings for all 20 trials were rank-ordered for each participant by increasing endorsement, and the corresponding EMG values were averaged across participants at each rank. Finally, the average EMG values were correlated with emotion rank.

Labeling of expressions used in self-report task

To examine whether the non-verbal self-report method that I employed separates anger from disgust, a separate group of 12 participants (7 female) matched canonical emotional facial expressions to written emotion descriptors. On each trial, participants viewed an array of emotional expressions (angry, disgusted, contemptuous, sad, fearful, surprised and happy; Matsumoto & Ekman, 1988) as well as a single written emotion descriptor. The task was to select the expression that was the best match for the descriptor. Descriptors were synonyms for the classical emotion terms. Four disgust-themed descriptors were presented (“tastes something bad”, “smells something bad”, “touches something dirty”, “grossed out”), as were four anger-themed labels (“frustrated”, “annoyed”, “pissed off”, “irritated”). Descriptors for contempt (“disapproving”), happiness (“cheery”), surprise (“amazed”), fear (“scared) and sadness (“glum”) were also presented. For analysis, responses to the four disgust-themed descriptors were collapsed together, as were response to the four anger-themed descriptors. The frequency with which the anger and disgust expressions were selected to match the anger- and disgust-themed descriptors was analyzed using chi-square tests.
Results and discussion

1. Self-reports: Manipulation check

The disgust expression was selected as the best match for disgust-relevant labels such as “tasting something bad” and “smelling something bad” in 85% of responses, while the anger expression was chosen in only 4% of responses (χ²(1) = 35.4, p < 0.001), and the contempt expression was never chosen. By contrast, the disgust expression was judged to portray anger-relevant labels such as “frustration” and being “pissed off” in only 12% of responses. Thus, participants felt that the disgust expression was the best match for feelings of disgust related to its primitive sensory origins.

2. Effects of fairness on offer acceptance and self-reported emotions

Participants accepted all equal ($5:$5) offers, with rejection rates increasing significantly as offers became increasingly unequal (F[1,15] = 46.7, p < 0.000). Past work has shown that strongly unequal offers are viewed as unfair (Pillutla & Murnighan, 1996), suggesting that a motivation to punish unfair proposers even at personal financial cost may underlie the rejection of unequal offers (Rabin, 1993; Falk & Fischbacher, 2006).

Of the seven emotions measured, four tracked the unfairness of offers: disgust, anger, and sadness endorsement increased, while happiness endorsement decreased, with increasing unfairness of offers (Figure 3A; main effect of offer: F[9,135] = 25.2, p < 0.000). In addition to reporting increasing disgust with increasing offer unfairness (F[1,135] = 64.8, p < 0.001), unfair offers evoked disgust to a greater degree than both anger (focused contrast: F[1,135] = 25.0, p < 0.001) and sadness (focused contrast: F[1,135] = 25.0, p < 0.001). In other words, when participants received unfair offers, they judged their experience as most similar to tasting or smelling something bad.

Endorsement of contempt, surprise and fear did not vary with the unfairness of offers (main effect of offer: F[3,45] = 1.36, p = .27). The lack of a fear effect seems unremarkable, since unfair offers posed no physical or social threat to participants. The null effect for surprise may indicate that participants had no strong a priori expectation that their partners would behave either fairly or unfairly in this novel experimental situation. Finally, the lack of a contempt effect
could suggest that this emotion is reserved for other types of transgressions (Rozin, Lowery et al., 1999). It is notable that the effect of unfairness on contempt was markedly different from its effect on disgust, implying that these emotions are not isomorphic.

3. Levator labii EMG

Confirming the subjective reports of disgust, levator labii region EMG was significantly affected by the type of offer presented. Specifically, the increase in self-reported disgust was paralleled by a parametric increase in levator labii region activity as offers became more unfair (Figure 3B; $F[1,45] = 6.34, p < .05$). Focused contrasts revealed that levator labii region activity was greater for $9:1$ offers (which were most often rejected; mean of 73% rejection) relative to $5:5$ and $7:3$ offers (which were most often accepted; mean of 10% rejection) ($F[1,45] = 9.32, p < .004$). The decrease in levator labii region activity for $7:3$ offers relative to $5:5$ was not statistically reliable (focused contrast: $F[1, 45] = 1.11, p = 0.29$).

The association between self-reported disgust and levator labii activity received further support from a significant correlation between disgust experience and the strength of levator labii region activity. Offers rated as more disgusting were associated with more activation of the levator labii region (Figure 3C; $r = .61, p < 0.01$). It is important to note that the period of EMG analysis preceded the viewing of facial expressions during self-report, to ensure the independence of these measures. Although anger and sadness endorsement also increased with increasing unfairness, these ratings did not correlate with levator labii region activity (Figures 3D and E: anger, $r = .14, p > 0.5$; sadness, $r = .052, p > 0.8$). Contempt, another emotion that has been theoretically linked to immorality (Rozin, Lowery et al., 1999), also did not correlate with activation of the levator labii region ($r = .26, p > 0.2$). Levator labii region activity was thus specifically related to feelings of tasting or smelling something bad. In sum, participants showed both subjective (self-report) and objective (facial motor) signs of disgust that were proportional to the degree of unfairness they experienced.
Figure 3. (A) Mean self-reported emotion in response to different offers in the Ultimatum Game. Only emotions that varied with offer type are shown. Higher numbers indicate greater endorsement. (B) Mean levator labii region EMG evoked by the different offers. Error bars are +1 SEM (within-subjects; 32). (C) Correlation between disgust ratings and levator labii region EMG. Linear fit is shown. (D) Correlation between anger ratings and levator labii region EMG, calculated as in D. (E) Correlation between sadness ratings and levator labii region EMG.

2.4 Chapter Discussion

Experiments 1-3 suggest that moral transgressions trigger facial motor activity that is also evoked by distasteful and physical disgust stimuli, even though the “bad taste” left by immorality is abstract rather than literal. Furthermore, subjective feelings of tasting or smelling something bad were evoked in response to unfairness. These results provide evidence for the primitive oral origins of moral disgust. They are also consistent with the idea that in humans, the rejection impulse characteristic of distaste may have been co-opted and expanded to reject offensive stimuli in the social domain (Rozin et al., 2000). Although some theories have proposed that sociomoral disgust is reserved for transgressions that are conceptually related to notions of social
contamination or purity, with anger and contempt being the more likely response to violations of individual rights and community norms (Rozin, Lowery et al., 1999), my data suggest that sociomoral disgust may in fact be triggered by a wider range of offenses. The role of disgust in active rejection and distancing could explain why immorality evokes this emotion in addition to others such as anger: while anger is associated with approach motivation (Harmon Jones, Sigelman, Bohlig, & Harmon-Jones, 2003), disgust may motivate vigorous withdrawal (Rozin et al., 2000).

Results from all three studies hinted a somewhat of a quadratic relationship between distaste/physical disgust/sociomoral disgust and levator labii activation. As mentioned previously, these findings could indicate a threshold effect, in which a certain level of arousal must be reached before levator labii activation is evident. Indeed, similar effects have been seen for EMG recordings from other facial muscle regions (Lang et al., 1993; Larsen et al., 2003). An interesting alternative is that moderate or ambivalent stimuli could actually suppress EMG activation to some degree (Larsen et al., 2003), perhaps due to the presence of conflicting emotions.

One possible objection to the use of facial behaviour as an index of subjectively experienced disgust is that facial signs of elevated disgust might actually reflect metaphorical social communication, conveying strong condemnation without actually indicating the subjective experience of disgust (Fridlund & Russell, 2006). However, a recent developmental study has shown that children as young as six years of age report that it is appropriate to call moral transgressions “disgusting” and match them to disgusted facial expressions (Danovitch & Bloom, 2009). Since children’s use of metaphor develops rapidly in early childhood, if their use of the term “disgusting” was metaphorical, we would expect it to increase with age. However, no developmental trend in the use of “disgusting” to describe transgressions was found, suggesting that it is not used primarily as a metaphor. Studies that have used implicit measures to examine disgust in response to sociomoral transgressions also argue against a social-communication explanation for the current results. For example, it seems unlikely that increased completion of word stems with disgust- or cleansing-related words (Zhong & Liljenquist, 2006; Jones & Fitness, 2008) could represent a deliberate effort to communicate. These experiments provide evidence that converges with the results presented in this chapter, to suggest that disgust evoked by sociomoral transgressions cannot be entirely attributed to metaphorical communication, but
rather appears to reflect a genuine disgust experience. This is not to say that sociomoral disgust is necessarily identical to physical disgust; indeed, the former is necessarily a much more complex phenomenon than the latter. Nevertheless, there does seem to be an underlying phenomenological continuity between the two states, as evidenced by the similarity in facial motor activity and self-reported experience described here.
Chapter 3  The Effects of Normal and Pathological Variation in Physical Disgust Sensitivity on Sociomoral Judgement and Emotion

In Chapter 2, I provided evidence that sociomoral transgressions elicit both objective (facial motor) and subjective (self-report) signs of disgust. In this chapter, I adopt a different approach to provide converging evidence for disgust as a sociomoral emotion. Specifically, I examine whether individual differences in the tendency to experience physical disgust are associated with differences in sociomoral judgement and emotion. The logic here is that individual differences in emotion tend to shape judgements in the same way as experimentally induced emotion (Lerner & Keltner, 2000). Accordingly, an association between physical disgust sensitivity and sociomoral judgement—which are superficially quite different—would imply that physical disgust has become incorporated into the cognitive and emotional systems that process morality and social convention. The experiments presented in Chapter 3 explore this possibility by examining emotion and sociomoral judgement in two groups: patients with obsessive-compulsive disorder (OCD) and undergraduate students who are high and low in physical disgust sensitivity.

Obsessive-compulsive disorder

OCD is a disabling neuropsychiatric condition with a lifetime prevalence of 2-3% (APA, 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 (APA, 2000). Because obsessions typically evoke considerable anxiety, OCD has most often been characterized as an anxiety disorder. However, recent evidence has also implicated physical disgust in the pathophysiology of OCD. Obsessive concerns about physical disgust-relevant stimuli such as dirt, ‘germs’ and contamination are common, as are washing compulsions (Rasmussen & Eisen, 1992). As well, individuals with OCD have higher physical disgust sensitivity than healthy controls (Woody & Tolin, 2002), and they are more likely to perceive objects as contaminated when they have indirectly contacted a physically disgusting substance (D. Tolin, Worhunsky, & Maltby, 2004). Finally, individuals with OCD show exaggerated neural responses to physically disgusting stimuli in brain regions that are sometimes associated with disgust processing, such as the anterior insula (Shapira et al., 2003).
Given that OCD may involve abnormalities in the physical disgust system, studies of individuals with OCD could provide a unique window into the role of disgust in morality and social convention. Specifically, if individuals with OCD are hypersensitive to physical disgust, as suggested by the literature, and disgust is an important sociomoral emotion, then sociomoral processing may also be altered in OCD. While individuals with OCD are known to have obsessions about issues of religion, morality and social convention (Abramowitz, Huppert, Cohen, Tolin, & Cahill, 2002), I am not aware of any formal investigations of sociomoral cognition and emotion in OCD.

To test for a possible connection between physical disgust and sociomoral processing, Experiment 4 examined sociomoral judgement and emotion in patients with OCD and healthy controls. Both groups were presented with short written scenarios describing transgressions; judgements and emotional responses were measured. One question of interest is whether pathological disgust processing in OCD will affect responses to both moral and conventional transgressions. I therefore presented scenarios describing both types of transgressions. In addition to collecting behavioural measures, I conducted an fMRI experiment to examine the neural correlates of sociomoral judgement in OCD and their relationship to physical disgust.

**Normal variation in disgust sensitivity**

Although research conducted in psychiatric populations can be very informative, it can also present certain practical challenges. In the present case, time constraints limited the length of the tests that I could administer to patients. As well, the nature of the clinical population is itself challenging. In particular, OCD patients are a very heterogeneous group in terms of their specific symptom patterns. While contamination concerns and washing compulsions are among the most OCD common symptoms (APA, 1994), some patients may present primarily with checking or hoarding concerns. This heterogeneity could be problematic, since my aim was to examine the consequences of heightened disgust sensitivity in OCD patients, which appears to be most strongly associated with washing symptoms (Berle & Phillips, 2006). However, obtaining an adequate number of patients with these symptoms can be challenging. To address these limitations, I conducted a behavioural companion study—Experiment 5—to examine the effects of normal variation in disgust sensitivity in a population of undergraduate students. This experiment allowed me to perform a more thorough investigation of sociomoral judgement and
emotion in a group of participants who were specially selected to display the desired high- and low-physical disgust phenotypes.

3.1 Experiment 4

Participants

Fifteen OCD patients were tested while participating in a larger study of cognitive-behavioural therapy conducted at the Centre for Addiction and Mental Health in Toronto. All testing for the current research was completed before the treatment study began. Diagnosis of primary OCD was confirmed with the Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1996), which was administered by a trained psychometrician. Individuals with current comorbid Axis I or II disorders, including major depressive disorder, were excluded. Patient demographics are given in Table 1. Note that sample sizes for some measures in the OCD group are less than the total N because of missing data.

Sixteen healthy controls were also tested. Control status was verified with the SCID. One control was excluded because of outlier scores on a key measure of sociomoral judgement, for a final control sample of size 15. Demographics for the control sample are given in Table 1.
Table 1. Demographic and clinical information for the OCD patients and controls in Experiment 4.

<table>
<thead>
<tr>
<th></th>
<th>OCD</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Age</td>
<td>30.6 (sd = 7.1, range 19-46)</td>
<td>32.8 (sd = 8.1, range 22-52)</td>
</tr>
<tr>
<td>Gender</td>
<td>8M, 7F</td>
<td>8M, 7F</td>
</tr>
<tr>
<td>Psychotropic medication</td>
<td>12 medicated patients:</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>10 SSRI, 4 antipsychotic, 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>buproprion, 1 anxiolytic</td>
<td></td>
</tr>
<tr>
<td>YBOCS</td>
<td>25.4 (sd = 7.0, range 14-38)</td>
<td>NA</td>
</tr>
<tr>
<td>Disgust Scale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20.3 (sd = 4.3)</td>
<td>12.0 (sd = 4.0)</td>
</tr>
<tr>
<td>PIOUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16.3 (sd = 17.5)</td>
<td>6.5 (sd = 7.0)</td>
</tr>
<tr>
<td>Fear of Sin</td>
<td>11.5 (sd = 11.2)</td>
<td>5.0 (sd = 4.5)</td>
</tr>
<tr>
<td>Fear of God</td>
<td>4.8 (sd = 6.9)</td>
<td>1.5 (sd = 2.8)</td>
</tr>
</tbody>
</table>

Measures

In patients, the global severity of OCD symptoms was assessed using the Yale-Brown Obsessive-Compulsive Scale (YBOCS; Goodman, Price, Rasmussen, Mazure, Fleischmann et al., 1989), a semi-structured clinical interview that includes a symptom checklist, a 10-item severity scale and the patient’s report of their primary or most problematic symptom. The YBOCS severity scale has good psychometric properties (Goodman, Price, Rasmussen, Mazure, Delgado et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann et al., 1989) and is among the most widely used measures of OCD symptom severity.

Patients and controls also completed the Disgust Scale (Haidt et al., 1994) and the Penn Inventory of Scrupulosity (PIOS; Abramowitz et al., 2002). The DS is a 32-item self-report measure of the tendency to experience disgust toward a variety of physical stimuli. The DS has acceptable internal consistency and convergent and discriminant validity (Haidt et al., 1994). The
PIOS measures individual differences in first-person concerns about religion and morality, known as *scrupulosity*. The PIOS consists of 19 items in two subscales, Fear of God (e.g. “I am afraid my behaviour is unacceptable to God”) and Fear of Sin (e.g. “I fear that I will act immorally”). This measure is internally consistent and has good convergent and discriminant validity (Abramowitz et al., 2002; Olatunji, Abramowitz, Williams, Connolly, & Lohr, 2007).

**Materials**

I developed 48 one- or two-sentence scenarios describing an action by a third-party actor. Sixteen of the scenarios described moral transgressions, 16 described conventional transgressions and 16 described neutral actions. All the scenarios were set in a highschool, an environment in which both moral and conventional rules are salient. Moral transgressions involved deliberate, unprovoked physical or psychological harm, theft or violations of trust (e.g. “a student steals a library book that other students need to pass an exam”; “a female student slaps another girl in the face”). Conventional transgressions involved violations of school rules (e.g. “a student asks the teacher a question in class without raising her hand first”; “a student wears a t-shirt and jeans to school instead of the school uniform”). Neutral actions described everyday events (e.g. “a student sits down at a table in the library and reads”; “a student calls his friend after school and they make plans to watch a movie together”). A full list of the scenarios can be found in Appendix 1. Moral and conventional transgressions were pilot-tested to ensure that the moral transgressions were viewed as independent of authority while the conventional transgressions were viewed as dependent on authority. A manipulation check of the moral-conventional distinction for the scenarios can be found in Experiment 5, in the section describing authority-dependence judgements.

**Procedure**

Prior to the scanning session, participants completed a pencil-and-paper sociomoral judgement task. Due to time constraints, nine scenarios from the full set were presented (three moral, three conventional and three neutral). Participants were instructed to read each scenario and imagine they were witnessing the events described. Participants first made a permissibility judgement (allowed/not allowed). If they judged that the action was not permissible, they made an authority-dependence judgement by deciding whether the action in question would be acceptable if the principal of the school said it was permitted. Finally, participants reported how they would
feel if they saw the action occur using 1-9 scales. Participants provided an overall rating of valence (good/bad), as well as anger and “sick to stomach” (STS), as an analogue for disgust. It was not possible to use the facial-expression endorsement method described in Experiment 3, because of evidence that patients with OCD have impairments in perceiving facial expressions of disgust (Sprengelmeyer et al., 1997; Corcoran, Woody, & Tolin, 2008). Accordingly, a verbal measure was needed, and STS was selected in an effort to avoid the known problems with the verbal label “disgust” (Nabi, 2002). While STS could suffer from the same lack of specificity as “disgust”, it at least directly references visceral sensations associated with the experience of disgust, which may disambiguate it from anger.

During the fMRI scanning session, participants performed another sociomoral judgement task, this time using the full set of scenarios. On each trial, participants were presented with a display consisting of the scenario plus a 1-9 rating scale which they used to judge the wrongness of the action (from “not at all” to “extremely”). Participants made their rating by manipulating a cursor using an fMRI-compatible button box. Each trial display lasted 10s, followed by 2s of fixation. Trials were presented in blocks of two scenarios of the same type (moral, conventional or neutral), for a total block length of 24s. Eight blocks of each type were presented, divided into two functional runs.

To examine the relationship between sociomoral judgement and physical disgust at the neural level, participants also completed a picture viewing fMRI task designed to localize the structures associated with physical disgust processing. Participants viewed 20s blocks of disgusting or neutral photographs. Disgusting photographs depicted disease, contamination, body products or injury; neutral photographs depicted landscapes, household objects or other ordinary scenes. Each photograph was presented for 3s, followed by a 1s interstimulus interval during which an arrow was presented pointing left or right. In order to maintain engagement, especially during the neutral blocks, participants were asked to indicate the direction of the arrow with a button-press. Blocks consisted of five photographs, and five blocks of each type were presented.

**FMRI acquisition**

Imaging data were collected on a 3T Siemens Tim Trio scanner. For each participant, a T2*-weighted gradient-echo echo-planar image (EPI) pulse sequence was prescribed and higher order shimmed for the functional trials. The EPI parameters were as follows: TE = 30 ms; TR = 2000
ms; flip angle = 270°; acquisition matrix = 64 x 64; FOV = 200 mm. Thirty axial oblique slices of the brain were acquired at each time point, with a voxel resolution of 3.1 x 3.1 x 5 mm, no skip between slices. A high-resolution T1-weighted structural image was also obtained for each participant using a three-dimensional magnetization-prepared rapid-acquisition gradient echo pulse sequence. The following imaging parameters were used: TR = 2000 ms; TE = 2.63 ms; matrix = 256 x 160; FOV = 256 x 256; slice thickness = 1 mm; 160 axial oblique slices.

**FMRI analysis**

1. **Preprocessing**

Functional activation for both the disgust localizer and sociomoral tasks was determined from the BOLD signal using Statistical Parametric Mapping software (SPM5, University College London, London, UK; http://www.fil.ion.ucl.ac.uk/spm/software/spm5). Following image reconstruction (SPM5 DICOM import utility), the time series data for each participant were motion corrected. One OCD patient had motion greater than one voxel and was excluded from the fMRI analyses; motion parameters were less than one voxel for all remaining participants. Functional images were then coregistered with their T1-weighted structural image. The T1 image was bias corrected and segmented using template tissue probability maps (International Consortium for Brain Mapping) for grey/white matter and CSF. Warping parameters were obtained from the tissue segmentation procedure and subsequently applied to the time series data (resampling to 3 mm³ voxels). The time series data were spatially smoothed to a 6 mm³ full-width half maximum Gaussian kernel. Finally, a voxel-level detrending procedure was applied to remove time series components correlated with global fluctuations in the BOLD signal (Macey, Macey, Kumar, & Harper, 2004).

2. **fMRI Statistical models**

   a. **Overview**

In SPM, statistical analysis of data from multiple subjects occurs in two stages or “levels”, somewhat analogous to hierarchical linear modeling (multilevel modeling). At the first level, separate within-subject analyses or “models” are computed for each participant. These analyses may contrast one condition with another, or just compute the activation associated with a single
condition (a positive-effect t-contrast). Contrasts from the first level are then entered into the second-level model to allow inferences about the population from which the subjects were sampled.

b. **First-level statistical models**

Using the SPM5 design specification, the condition-specific boxcar stimulus functions were convolved with the canonical hemodynamic response function (HRF). Each subject’s model included within-session global scaling, high-pass filtering to remove low-frequency signal drift (period =128 s for the disgust localizer and 300 s for the sociomoral task), and the AR1 method of estimating temporal autocorrelation. For the sociomoral task, first-level positive-effect t-contrasts were computed for the moral, conventional and neutral conditions. Directional contrasts comparing moral to neutral (moral>neutral) and conventional to neutral (conventional>neutral) were also computed. For the disgust localizer task, first-level positive-effect t-contrasts were computed for the disgust and neutral conditions.

c. **Second-level statistical models**

Second-level statistical models are described in more detail in the results section below. Unless otherwise specified, all analyses used a statistical threshold of p<0.001 (uncorrected) and an extent threshold of at least five contiguous voxels.

**Results**

1. **YBOCS, DS and PIOS**

YBOCS scores in the patient group ranged from 14-38, with a mean score of 25.4, comparable to other clinical samples (Goodman, Price, Rasmussen, Mazure, Delgado et al., 1989; Mataix-Cols et al., 2004). The primary or most troubling symptom reported in the YBOCS provides an indication of the type of symptoms experienced by each patient. Seven patients reported primary washing symptoms, while eight patients reported checking as their primary symptom. Note that these groups are not necessarily mutually exclusive, since this measure describes only the patient’s primary symptom, and patients may have other symptoms which are not as troubling.
OCD patients had significantly higher DS scores than controls (Table 1; \( t[24] = 5.05, p < 0.001 \)). However, within the patient group, there was no correlation between scores on the DS and YBOCS (\( r = 0.097, p = 0.741 \)). One possibility is that DS may be a stronger predictor of OCD symptom severity in patients for whom washing is a primary concern. However, the DS did not differ significantly between washers and non-washers (\( t[12] = 1.23, p = 0.24 \)), although the sample sizes for this comparison are very small given missing data (6 washers, 8 non-washers).

Patients scored on average nearly 10 points higher than controls on the PIOS total scale (Table 1). However, this difference was only near-significant (\( t[25] = 1.94, p = 0.064 \)). Examining the two PIOS subscales separately reveals that patients differed from controls primarily on the Fear of Sin subscale (\( t[25] = 2.00, p = 0.056 \)) rather than the Fear of God subscale (\( t[25] = 1.64, p = 0.113 \)). Moral hypersensitivity in the patient group thus appears to be more related to concerns about committing transgressions than to religious concerns.

Within the OCD group, PIOS scores were not correlated with the YBOCS, for either the PIOS full scale (\( r = -0.085, p = .781 \)), PIOS Fear of Sin scale (\( r = -0.039, p = 0.900 \)) or PIOS Fear of God Scale (\( r = -0.155, p = 0.614 \)). PIOS scores did not differ significantly between washers and non-washers (\( t’s < 1 \)), again with the caveat of small sample sizes (5 washers, 8 non-washers).

Across both groups, scores on the DS and PIOS full scale were correlated (\( r = 0.391, p = 0.054 \)). Breaking this down according to PIOS subscale, the DS was significantly correlated with Fear of Sin (\( r = 0.414, p =0.040 \)), but not significantly with Fear of God (\( r = 0.318, p = 0.121 \)).

2. Moral judgement

There was a significant main effect of scenario type on wrongness ratings \( F[2,54] = 392.0, p < 0.001 \), as well as a significant main effect of group \( (F[1,27] = 5.52, p = 0.026) \), but no significant interaction \( (F[2,54] = 1.12, p = 0.310) \). Figure 4 (left panel) shows that OCD patients judged both moral and conventional transgressions to be more wrong than controls.

To examine the relationship between OCD symptom severity and wrongness judgements, I first performed correlations between YBOCS scores and wrongness ratings for the moral and conventional transgressions. Neither of these correlations were significant (both \( p’s > 0.7 \)). In a second approach, I compared the wrongness ratings of the six patients with the most severe OCD
(YBOCS ≥ 30) to the other eight OCD patients for whom wrongness data were available and the controls (Figure 4, middle panel). Although power is relatively low, this analysis revealed a near significant effect of group (F[2,26] = 3.15, p = 0.060), as well as the expected main effect of scenario type (F[2,52] = 338.4, p < 0.001), but no significant interaction (F<1). Unexpectedly, patients with moderate OCD judged the scenarios to be most wrong, followed by patients with severe OCD and controls. However, given the small sample sizes in the OCD subgroups, this result should be treated with caution.

Figure 4. Mean wrongness judgements for OCD patients and controls in Experiment 4.

Although increasing severity of OCD symptoms does not appear to be linearly related to wrongness judgements, there could be a relationship between different OCD subtypes and wrongness ratings. To test this possibility, I compared the six patients with washing symptoms to the eight patients without these symptoms and to controls. Results of this analysis are shown in Figure 4 (right panel). In addition to the expected main effect of type (F[2,52] = 380.5, p < 0.001), there was a significant effect of group (F[2,26] = 3.92, p = 0.032) and a near-significant interaction (F[4,52] = 2.43, p = 0.059). OCD patients with washing concerns rated the conventional transgressions as marginally more wrong than did OCD patients with other concerns (t[12] = 2.14, p = 0.054).

In a final analysis, I examined the relationship between DS scores and wrongness judgements across groups. There was a significant correlation between DS scores and wrongness judgments for moral transgressions (r = 0.424, p = 0.032), and a weak correlation for conventional transgressions (r = 0.314, p = 0.126). However, scatterplots of the data suggest that the two patients with the highest DS scores may have been responsible for this effect, and indeed,
excluding them from these correlations eliminated the significance of the effects. The possible relationship between DS scores and wrongness judgements thus remains ambiguous, in the absence of data from other patients with extreme scores on the DS.

3. **Authority-dependence**

Judgements of authority-dependence are concerned with whether the wrongness or impermissibility of a transgression is due to the dictates of an external authority. In the current experiment, authority-dependence was operationalized by asking whether, given that a transgression was judged to be impermissible, it would be “ok” if the principal of the school said it was ok. I was especially interested in reversals of judgement—i.e., a switch from impermissible to permissible if the principal said it was ok—because such reversals suggest that the wrongness of the transgression depends on external rules. To examine authority-dependence, I calculated the proportion of judgement reversals made by each participant, relative to the number of times the transgressions were judged to be impermissible. Since only a negligible number of neutral scenarios were judged to be impermissible, I focused on conventional and moral transgressions. In the current experiment this analysis is limited to an exploratory assessment, since authority-dependence judgements were available for only three conventional and three moral transgressions. Given the low number of items, proportion scores have a limited distribution, and accordingly a continuous analysis is not appropriate. However, given the small sample size, a chi-squared test also cannot be performed, since the analysis is inappropriate for expected cell sizes lower than 5. Nevertheless, some preliminary conclusions can be drawn from contingency tables (Tables 2 and 3). Table 2 shows that in both patients and controls, the great majority of individuals judged that none of the moral transgressions were dependent on external authority. That is, in both groups, most people judged that moral transgressions would still be impermissible even if the principal said they were permitted. This pattern did not seem to differ between groups.

In contrast to the moral transgressions, the majority of patients and controls judged that all (100%) or most (67%) of the conventional transgressions were authority-dependent (Table 3). In other words, conventional transgressions would be permissible if the principal said they were ok. Again, this pattern did not appear to differ between groups. Thus, individuals with OCD and controls did not seem to differ in their judgements of the authority-dependence of different kinds
of rules. In particular, I found no evidence that individuals with OCD “moralize” conventional transgressions.

Table 2. Authority-dependence judgements for moral transgressions in patients and controls. Cells give the number of individuals who made a particular proportion of judgements.

<table>
<thead>
<tr>
<th>Proportion judged to be authority-dependent</th>
<th>Controls</th>
<th>OCD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 %</td>
<td>14</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>33 %</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>14</td>
<td>29</td>
</tr>
</tbody>
</table>

Table 3. Authority-dependence judgements for conventional transgressions in patients and controls. Cells give the number of individuals who made a particular proportion of judgments.

<table>
<thead>
<tr>
<th>Proportion judged to be authority-dependent</th>
<th>Controls</th>
<th>OCD</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 %</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>33 %</td>
<td>0</td>
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<td>1</td>
</tr>
<tr>
<td>50%</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>67 %</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>100 %</td>
<td>11</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>13</td>
<td>27</td>
</tr>
</tbody>
</table>

4. Emotion ratings

Separate ANOVAs were performed to examine the effect of group on ratings of valence, anger, and “sick to stomach” in response to the scenarios. Figure 5 shows a main effect of scenario type on all three ratings (test statistics given in Table 4). There was no difference between patients and controls for ratings of overall valence or anger; however, patients reported that they would
feel significantly more “sick to stomach” than controls. A near-significant interaction suggests that this effect was strongest for the moral transgressions.

![Figure 5. Mean emotion ratings for OCD patients and controls in Experiment 4.](image)

Table 4. Test statistics for ANOVAs examining the effects of scenario type and group on emotion ratings in Experiment 4.

<table>
<thead>
<tr>
<th></th>
<th>Main effect: Type</th>
<th>Main effect: Group</th>
<th>Interaction</th>
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<tbody>
<tr>
<td></td>
<td>df = 2,54</td>
<td>df = 1,27</td>
<td>df = 2,54</td>
</tr>
<tr>
<td>Valence</td>
<td>F = 149.1</td>
<td>F = 3.18</td>
<td>F = 0.551</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001</td>
<td>p = 0.086</td>
<td>ns</td>
</tr>
<tr>
<td>Anger</td>
<td>F = 272.2</td>
<td>F = 0.003</td>
<td>F = 0.149</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001</td>
<td>p = 0.958</td>
<td>p = 0.862</td>
</tr>
<tr>
<td>Disgust</td>
<td>F = 43.5</td>
<td>F = 6.57</td>
<td>F = 2.88</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001</td>
<td>p = 0.016</td>
<td>p = 0.065</td>
</tr>
</tbody>
</table>

As for the wrongness ratings, I examined the effect of OCD symptom severity on emotional reactions. Because differences between patients and controls were seen only in the “sick to stomach” ratings, I compared these ratings for patients with severe and moderate OCD

---

3 Different effects of group on anger and “sick to stomach” ratings suggest that these verbal measures succeeded at least partially at disentangling anger from disgust.
symptoms as well as controls. This analysis showed a near-significant main effect of group (F[2,26] = 3.17, p = 0.059) and a marginal interaction (F[4,52] = 2.08, p = 0.097). Figure 6 (left panel) shows the directionality of these somewhat weak effects. Although there is something of a crossover interaction for the two OCD groups, direct comparisons for the moral and conventional transgressions did not reveal significant differences between patients with moderate and severe OCD symptoms (t’s > 1.1). Comparing OCD patients with washing symptoms to patients with other symptoms and controls revealed a significant effect of group (F[2,25] = 4.35, p = 0.024) but no significant interaction (F[4,50] = 1.26, p = 0.297; Figure 6, right panel).

![Figure 6](image_url)

Figure 6. “Sick to stomach” ratings in Experiment 4, broken down according to OCD symptom severity (left panel) and symptom type (right panel).

Lastly, I performed a correlation between scores on the DS and sick to stomach ratings, across both groups. Sick to stomach ratings for moral transgressions were significantly correlated with DS scores (r = 0.515, p < 0.007), but not with ratings for conventional transgressions (r < 0.1). Plots of the data did not suggest overly influential outliers.

5. FMRI results

Past work has tied disgust most frequently to activation of the insula (Phillips et al., 1997; Schienle et al., 2002; Wright et al., 2004; Harrison et al., 2010). Effects of OCD in this region are therefore of a priori interest, as is overlap between the neural correlates of physical disgust
and sociomoral transgressions. Some caution is warranted in inferring that insular activation necessarily reflects disgust, however, since the insula also supports a number of other functions (Craig, 2009). I will also comment upon the possible functions of some other regions observed in the analyses that follow, although once again attributions of cognitive function to particular brain regions should be treated as tentative (Poldrack, 2006).

a. Neural correlates of sociomoral judgement in controls

I first consider the neural correlates of sociomoral judgement in the control group. Activation common to the moral and conventional conditions (but distinct from neutral) was examined using the conjunction of the contrasts moral>neutral and conventional>neutral. This conjunction revealed activation in bilateral anterior insula/frontal operculum, precuneus, dorsal anterior cingulate cortex (dACC) and inferior parietal lobe as well as widespread lateral frontal activation (Figure 7; Table 5 gives the full set of regions activated in this conjunction). The midline regions activated in this analysis—precuneus and dACC—are commonly observed in tasks that involve self-referential processing, mentalizing or imagery (Cavanna & Trimble, 2006; Mitchell, 2009). Increased activation of these regions in sociomoral judgement may thus indicate that an increased burden of imagery or mentalizing is involved in forming a judgement of another’s inappropriate behaviour. The lateral parietal and frontal regions may support judgement through attentional (Ciaramelli, Grady, & Moscovitch, 2008) executive (Miller & Cohen, 2001), or working memory processes (Curtis & D'Esposito, 2003). There is also evidence that inferior parietal lobe is a component of the mirror neuron system (Molenberghs, Cunnington, & Mattingley, 2009), suggesting that simulation may contribute to sociomoral judgement.
Figure 7. Activation common to the moral and conventional conditions in controls, as revealed by the conjunction of moral>neutral and conventional>neutral. Thermometer gives t-values.

Activation of anterior insula in this conjunction may indicate increased emotional processing during sociomoral judgement. In particular, and as mentioned previously, anterior insula is often activated by physical disgust stimuli (Schienle et al., 2002; Wright et al., 2004; Schienle, Schafer, Stark, Walter, & Vaitl, 2005a; Harrison et al., 2010), and it is therefore possible that sociomoral judgement shares some of the emotional processing substrates of physical disgust. To test this hypothesis more formally, I added a third contrast to the conjunction described above: physical disgust photographs>neutral photographs. This three-way conjunction analysis revealed a cluster of 24 voxels in left anterior insula and a smaller cluster of 4 voxels in right anterior insula (Figure 8) that are indeed activated in response to both sociomoral judgement and physical disgust. The full list of regions activated in this conjunction is given in Table 6.
Figure 8. Bilateral anterior insula activity in the control group revealed by the three-way conjunction of physical disgust photographs > neutral photographs, moral > neutral and conventional > neutral.

I next separately examined activations for the conventional and moral conditions. To do so, I made use of the first-level conventional>neutral and moral>neutral contrasts. The second-level contrast [conventional>neutral] > [moral>neutral] reveals regions that are more strongly activated by the conventional condition than the moral condition. As shown in Figure 9 and detailed in Table 7, activated regions included posterior cingulate/precuneus, ventromedial prefrontal cortex (vmPFC), and right angular gyrus. The latter two regions are particularly interesting. One study has shown that vmPFC is more strongly activated when participants make explicit moral judgements than when passively viewing photographs of moral transgressions (Harenski, Antonenko, Shane, & Kiehl, 2010), and indeed, vmPFC is a classical evaluative region (Rangel & Hare). Angular gyrus is in the temporoparietal junction (TPJ) region, and is strongly implicated in theory of mind (TOM) tasks (Young, Dodell-Feder, & Saxe; Saxe & Kanwisher, 2003). Taken together, these regions of activation suggest that making conventional judgements may require additional evaluative and social cognitive processing relative to making moral judgements, perhaps because of the need to consider social systems and shared norms of behaviour when contemplating conventional transgressions.
Figure 9. Greater activation to the conventional condition compared to the moral condition. Contrast shown is [conventional>neutral] > [moral>neutral].

The reverse contrast [moral>neutral] > [conventional>neutral] serves to isolate regions that are more strongly activated in the moral condition. This analysis uncovered largely visual and motor regions, as well as cerebellar activation (Table 8). Thus, the moral condition adds little to the shared correlates of sociomoral judgement. This is striking, given that the moral transgressions were rated as more wrong (Figure 4) and as more emotionally arousing (Figure 5) than the conventional transgressions. The fMRI results therefore imply that additional emotional processing is not critical to judging a transgression to be more wrong, contrary to claims that affective judgements form the primary basis of moral judgement (Haidt, 2001; Greene & Haidt, 2002). Rather, the shared neural correlates of judgement—those that are common to both moral and conventional transgression—appear to do most of the work involved in evaluating moral transgressions.
Table 5. Full list of regions revealed by the conjunction of the contrasts moral>neutral and conventional>neutral in the control group only.

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>BA</th>
<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t</th>
<th>x</th>
<th>y</th>
<th>z (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle cingulate</td>
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<td>R</td>
<td>1584</td>
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<td>24</td>
<td>39</td>
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<tr>
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<td>239</td>
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<td>-36</td>
<td>-66</td>
<td>-27</td>
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<tr>
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<td>3</td>
<td>12</td>
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<td>-12</td>
<td>9</td>
<td>6</td>
</tr>
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<td>45</td>
<td>-45</td>
<td>48</td>
</tr>
<tr>
<td>Frontal operculum/ Anterior insula</td>
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<td>6.18</td>
<td>-39</td>
<td>21</td>
<td>-12</td>
</tr>
<tr>
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<td>-66</td>
<td>45</td>
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<tr>
<td>Inferior frontal gyrus</td>
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<tr>
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<td>18</td>
<td>4.3</td>
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<td>-84</td>
<td>-21</td>
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<tr>
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<td>-21</td>
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<td>Intraparietal sulcus</td>
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<td>39</td>
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<tr>
<td>Orbitofrontal</td>
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<td>3.74</td>
<td>-45</td>
<td>48</td>
<td>-15</td>
</tr>
</tbody>
</table>

Note: BA = Brodmann area. Peak voxel coordinates are given in mm, using the Montreal Neurological Institute coordinate system.
Table 6. Full list of regions revealed by the three-way conjunction of the contrasts physical disgust photographs>neutral photographs, moral>neutral and conventional>neutral in the control group only.

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>BA</th>
<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t x</th>
<th>y</th>
<th>z (mm)</th>
</tr>
</thead>
<tbody>
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<td>Inferior frontal lobe</td>
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<td>L</td>
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<tr>
<td>Globus pallidus</td>
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<td>15</td>
<td>12</td>
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<td>Anterior insula/frontal operculum</td>
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<td>24</td>
<td>3.84</td>
<td>-27</td>
<td>24</td>
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<tr>
<td>Globus pallidus</td>
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<td>3.66</td>
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<td>6</td>
</tr>
<tr>
<td>Anterior insula/frontal operculum</td>
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<td>R</td>
<td>4</td>
<td>3.48</td>
<td>33</td>
<td>24</td>
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</tbody>
</table>
Table 7. Full list of regions revealed by the contrast [conventional>neutral] > [moral>neutral].

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>BA</th>
<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t</th>
<th>x</th>
<th>y</th>
<th>z (mm)</th>
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<tr>
<td>Posterior cingulate</td>
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<td>-39</td>
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<tr>
<td>Cerebellum</td>
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<td></td>
<td>3.65</td>
<td>-42</td>
<td>-75</td>
<td>-33</td>
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<td>-87</td>
<td>-42</td>
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<td>Gyrus rectus</td>
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<td>36</td>
<td>-18</td>
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</tbody>
</table>
Table 8. Full list of regions activated by the contrast [moral>neutral] > [conventional>neutral] in controls only.

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>BA</th>
<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t x</th>
<th>y</th>
<th>z (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle occipital</td>
<td>19</td>
<td>L</td>
<td>934</td>
<td>6.88</td>
<td>-42</td>
<td>-75</td>
</tr>
<tr>
<td>Lingual gyrus</td>
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<td>R</td>
<td>833</td>
<td>6.62</td>
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<tr>
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<td>R</td>
<td>52</td>
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<td>27</td>
<td>-36</td>
</tr>
<tr>
<td>Precentral gyrus</td>
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<td>L</td>
<td>19</td>
<td>5.46</td>
<td>-54</td>
<td>3</td>
</tr>
<tr>
<td>Fusiform</td>
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<td>L</td>
<td>84</td>
<td>5.33</td>
<td>-42</td>
<td>-51</td>
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<tr>
<td>Superior</td>
<td></td>
<td>R</td>
<td>7</td>
<td>5.22</td>
<td>6</td>
<td>-30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>9</td>
<td>5.12</td>
<td>-24</td>
<td>-27</td>
</tr>
<tr>
<td>Hippocampus</td>
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<td>R</td>
<td>73</td>
<td>4.93</td>
<td>30</td>
<td>-81</td>
</tr>
<tr>
<td>Middle occipital</td>
<td>19</td>
<td>R</td>
<td>73</td>
<td>4.93</td>
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<td>-81</td>
</tr>
<tr>
<td>Precentral</td>
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<td>L</td>
<td>15</td>
<td>4.84</td>
<td>-39</td>
<td>0</td>
</tr>
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<td>Thalamus</td>
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<td>-18</td>
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<td>Cerebellum</td>
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<td>4.65</td>
<td>-24</td>
<td>-39</td>
</tr>
<tr>
<td>Basal forebrain</td>
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<td>-3</td>
</tr>
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<td>Cerebellum</td>
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<td>3.97</td>
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<td>-63</td>
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<td>L</td>
<td>6</td>
<td>3.93</td>
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<td>-30</td>
</tr>
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<td></td>
<td></td>
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</tr>
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<td></td>
<td>R</td>
<td>13</td>
<td>3.83</td>
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<td>-63</td>
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<td>R</td>
<td>13</td>
<td>3.83</td>
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<td>-63</td>
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<td>L</td>
<td>6</td>
<td>3.74</td>
<td>-30</td>
<td>-66</td>
</tr>
</tbody>
</table>
b. Neural correlates of sociomoral judgement in patients

Although I am primarily interested in differences between patients and controls, I will briefly touch upon the neural correlates of sociomoral judgement in patients alone. Of particular interest is whether patients also show the anterior insula activation seen in controls in response to sociomoral transgressions. Indeed, the conjunction of moral > neutral and conventional > neutral in the patients yielded a large cluster in left anterior insula, very similar to the controls (Figure 10; Table 9 gives the full list of activated regions). Also similar to controls, adding the contrast physical disgust photographs > neutral photographs to the conjunction revealed a small cluster (3 voxels) in left anterior insula that was commonly activated to physical disgust and sociomoral judgement, albeit at a lowered significance threshold (p<0.005; Figure 11 and Table 10).

Figure 10. Activation common to the moral and conventional conditions in patients, as revealed by the conjunction of moral>neutral and conventional>neutral.
Figure 11. Left anterior insula activity in the patient group revealed by the three-way conjunction of physical disgust photographs > neutral photographs, moral > neutral and conventional > neutral.
Table 9. Full list of activated regions in the conjunction of moral>neutral and conventional>neutral in the patient group only.

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>BA</th>
<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t x</th>
<th>y</th>
<th>z (mm)</th>
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<tr>
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<td></td>
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<td>45</td>
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<td>Orbitofrontal cortex</td>
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<td>L</td>
<td>101</td>
<td>5.23</td>
<td>-39</td>
<td>21</td>
</tr>
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<td></td>
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<td>-21</td>
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<tr>
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<td>4.47</td>
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</tr>
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<td>10</td>
<td>L</td>
<td>47</td>
<td>4.04</td>
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<td></td>
<td>15</td>
</tr>
<tr>
<td>Inferior frontal gyrus</td>
<td>48</td>
<td>L</td>
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<td>3.87</td>
<td>-42</td>
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<tr>
<td>Middle frontal gyrus</td>
<td>46</td>
<td>L</td>
<td>17</td>
<td>3.85</td>
<td>-42</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>9</td>
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<tr>
<td>Precentral gyrus</td>
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<td>R</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>48</td>
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</tbody>
</table>
Table 10. Full list of regions activated in the three-way conjunction of physical disgust photographs > neutral photographs, moral > neutral and conventional > neutral in patients only.

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>BA</th>
<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t x</th>
<th>y</th>
<th>z (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial prefrontal cortex</td>
<td>32</td>
<td>L</td>
<td>15</td>
<td>3.1</td>
<td>-3</td>
<td>51</td>
</tr>
<tr>
<td>Anterior insula</td>
<td>48</td>
<td>L</td>
<td>3</td>
<td>2.85</td>
<td>-39</td>
<td>15</td>
</tr>
</tbody>
</table>
c. Differences between patients and controls

I next consider differences between patients and controls in the neural correlates of sociomoral judgment. All of the following analyses were performed on the first-level moral>neutral and conventional>neutral contrasts. To begin, I examined group differences that occur for both moral and conventional transgressions. To isolate regions that are more active for patients than controls, I computed the second-level conjunction of two contrasts: [patients moral>patients neutral] > [controls moral>controls neutral] and [patients conventional>patients neutral] > [controls conventional>controls neutral]. Put into words, this conjunction searches for regions that are more active in patients than controls for both moral and conventional transgressions. This analysis revealed activation in middle cingulate and dACC, and in mid- to posterior insula (Figure 12; see Table 11 for full list of activated regions). More caudal insular regions have been associated with disgust related to blood and injuries (Harrison et al., 2010), suggesting that changes in visceral-affective processes in OCD patients could contribute to moral hypersensitivity in this group. Enhanced activation in dACC is also intriguing, given that this region is closely associated with error monitoring (Holroyd & Coles, 2002), and that OCD patients have been found to show hyperactive error monitoring processes (Stern et al.; Endrass, Klawohn, Schuster, & Kathmann, 2008). If sociomoral transgressions are broadly construed as “errors”, then enhanced activation of dACC to sociomoral transgressions in patients could contribute to the observed behavioural differences, in combination with stronger affective responses perhaps related to increased insular activation.
To search for regions more active in controls than patients, I computed the conjunction of [controls moral>controls neutral] > [patients moral>patients neutral] and [controls conventional>controls neutral] > [patients conventional>patients neutral]. This analysis did not reveal any clusters larger than 3 voxels at a significance level of p<0.001. At the somewhat less stringent threshold of p<0.005, greater activation for controls than for patients was seen in precuneus, lateral orbitofrontal cortex (OFC) and dorsolateral prefrontal cortex (BA 9; Table 12). Increased DLPFC activation in controls relative to patients could indicate less regulatory activity in patients, which may contribute to stronger emotional responses and higher wrongness ratings in response to the transgressions (Greene et al., 2001).

To examine group differences where activation for patients was greater than for controls specifically in the conventional condition, I used the contrast [patients conventional>patients neutral] > [controls conventional>controls neutral]. This analysis revealed a set of regions quite similar to that seen for the conjunction of moral and conventional, including dACC, middle cingulate, mid- and posterior insula, as well as a region of dorsal medial prefrontal cortex (BA 10; Table 13). The latter region does not appear to be unique to the conventional condition, however, since the conjunction of moral and conventional produced activation in a very similar region at a relaxed significance threshold (p < 0.01). There was only one small cluster where activation was higher for controls than for patients in the conventional condition, in lingual gyrus in occipital cortex (Table 14).
The same analyses conducted in the moral condition also yielded results that were very similar to the conjunction of moral and conventional. Regions where activation for patients exceeded that for controls ([patients moral>patients neutral] > [controls moral>controls neutral]) included dACC, middle cingulate, mid- and posterior insula (Table 15). Table 16 gives regions where activation for controls in the moral condition was higher than for patients ([controls moral>controls neutral] > [patients moral>patients neutral]). Once again, this analysis was very similar to the conjunction of moral and conventional, including precuneus and lateral prefrontal cortex. In sum, the similarity between the analyses conducted separately for moral and conventional transgressions and the conjunction analysis suggests that the same processes underlie patient-control differences in both conditions. That is, patients likely have a single set of emotional and cognitive abnormalities that affect processing of both moral and conventional transgressions, rather than two sets of abnormalities that differentially affect moral and conventional judgement.
Table 11. Full list of regions activated in the conjunction of [patients moral>patients neutral] > [controls moral>controls neutral] and [patients conventional>patients neutral] > [controls moral>controls neutral].

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>BA</th>
<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t</th>
<th>x</th>
<th>y</th>
<th>z (mm)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>23</td>
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<td>13</td>
<td>4.22</td>
<td>9</td>
<td>-15</td>
<td>42</td>
</tr>
<tr>
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<td>L</td>
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<td>-48</td>
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<td>54</td>
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<td>Rolandic operculum</td>
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<td>L</td>
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<td>-12</td>
<td>21</td>
</tr>
<tr>
<td>Anterior cingulate</td>
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<td>R</td>
<td>13</td>
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<td>3</td>
<td>9</td>
<td>36</td>
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<tr>
<td>Posterior insula</td>
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<td>L</td>
<td>17</td>
<td>3.83</td>
<td>-33</td>
<td>-18</td>
<td>6</td>
</tr>
<tr>
<td>Posterior insula</td>
<td>48</td>
<td>R</td>
<td>11</td>
<td>3.66</td>
<td>39</td>
<td>-9</td>
<td>12</td>
</tr>
<tr>
<td>Posterior insula</td>
<td>48</td>
<td>L</td>
<td>7</td>
<td>3.51</td>
<td>-33</td>
<td>-21</td>
<td>18</td>
</tr>
</tbody>
</table>
Table 12. Full list of regions activated in the conjunction of [controls moral > neutral] > [patients moral > neutral] and [controls conventional > neutral] > [patients moral > neutral].

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>BA</th>
<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t</th>
<th>x</th>
<th>y</th>
<th>z (mm)</th>
</tr>
</thead>
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<tr>
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<td>4.03</td>
<td>42</td>
<td>-66</td>
<td>-24</td>
<td></td>
</tr>
<tr>
<td>Precuneus</td>
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<td>21</td>
<td>3.6</td>
<td>6</td>
<td>-66</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Lateral OFC</td>
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<td>3.59</td>
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<td>3.49</td>
<td>24</td>
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<td>-45</td>
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</tr>
<tr>
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<td>33</td>
<td>48</td>
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</table>
Table 13. Activated regions for the contrast [patients conventional>patients neutral] > [controls conventional > controls neutral].

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>BA</th>
<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t</th>
<th>x</th>
<th>y</th>
<th>z (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle insula</td>
<td>48</td>
<td>L</td>
<td>130</td>
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<tr>
<td>Frontoparietal operculum</td>
<td>3</td>
<td>L</td>
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<td>Precentral gyrus</td>
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<td>L</td>
<td>113</td>
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<td>-24</td>
<td>66</td>
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<td>R</td>
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<td>12</td>
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<td>Paracentral lobule</td>
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<td>-36</td>
<td>72</td>
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<tr>
<td>Lingual gyrus</td>
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<td>27</td>
<td>3.75</td>
<td>9</td>
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<td>0</td>
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<tr>
<td>Superior temporal sulcus</td>
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<td>8</td>
<td>3.73</td>
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<td>-36</td>
<td>21</td>
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</tbody>
</table>
Table 14. Activated regions for the contrast [controls conventional>controls neutral] > [patients conventional > patients neutral].

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<tr>
<th>Anatomic region</th>
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<th>Side</th>
<th>Cluster size (voxels)</th>
<th>Peak voxel t</th>
<th>x</th>
<th>y</th>
<th>z (mm)</th>
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<tr>
<td>Lingual gyrus</td>
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<td>-87</td>
<td>0</td>
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</tbody>
</table>

Table 15. Activated regions for the contrast [patients moral>patients neutral] > [controls moral>controls neutral].

<table>
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<th>Anatomic region</th>
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<th>Cluster size (voxels)</th>
<th>Peak voxel t</th>
<th>x</th>
<th>y</th>
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</tr>
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<td>0</td>
<td>-6</td>
<td>48</td>
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<td>23</td>
<td>R</td>
<td>19</td>
<td>4.42</td>
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<td>-15</td>
<td>45</td>
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<td>Frontoparietal operculum</td>
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<td>-12</td>
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<tr>
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<td>11</td>
<td>3.66</td>
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<td>-9</td>
<td>12</td>
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</table>
Table 16. Activated regions for the contrast [controls moral>controls neutral] > [patients moral>patients neutral].

<table>
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<th>Anatomic region</th>
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<th>Cluster size (voxels)</th>
<th>Peak voxel t x</th>
<th>y</th>
<th>z (mm)</th>
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<tbody>
<tr>
<td>Cerebellum</td>
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<td>94</td>
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<td>R</td>
<td>165</td>
<td>5.3</td>
<td>6</td>
<td>-66</td>
</tr>
<tr>
<td>Superior frontal gyrus</td>
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<td>R</td>
<td>99</td>
<td>5.08</td>
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<td>24</td>
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<tr>
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<td>L</td>
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<td>-69</td>
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<tr>
<td>Cerebellum</td>
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<td>R</td>
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<td>4.53</td>
<td>24</td>
<td>-39</td>
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<tr>
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<td>L</td>
<td>39</td>
<td>4.45</td>
<td>-39</td>
<td>-66</td>
</tr>
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<td>Middle cingulate</td>
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<td>R</td>
<td>10</td>
<td>4.23</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
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<td>4.21</td>
<td>-15</td>
<td>-90</td>
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<td>4.2</td>
<td>15</td>
<td>3</td>
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<td>46</td>
<td>R</td>
<td>29</td>
<td>4.19</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
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<td>L</td>
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<td>Cerebellum</td>
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<td>L</td>
<td>5</td>
<td>3.99</td>
<td>-9</td>
<td>-39</td>
</tr>
<tr>
<td>Caudate</td>
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<td>L</td>
<td>8</td>
<td>3.84</td>
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<td>3.74</td>
<td>-21</td>
<td>-30</td>
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<tr>
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<td>R</td>
<td>23</td>
<td>3.69</td>
<td>36</td>
<td>51</td>
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<tr>
<td>Cerebellum</td>
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<td>L</td>
<td>5</td>
<td>3.69</td>
<td>-36</td>
<td>-66</td>
</tr>
<tr>
<td>Superior parietal</td>
<td>7</td>
<td>L</td>
<td>7</td>
<td>3.68</td>
<td>-24</td>
<td>-57</td>
</tr>
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<td>Precuneus</td>
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<td>3.6</td>
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<td>-60</td>
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<td>-75</td>
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<td></td>
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<td>-15</td>
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</tbody>
</table>
Discussion

The goal of Experiment 4 was to examine sociomoral judgment and emotion in OCD, and in doing so to examine the relationship between physical disgust, morality and social convention.

Consistent with previous research (Woody & Tolin, 2002; Tolin, Woods, & Abramowitz, 2006; Olatunji, Lohr, Sawchuk, & Tolin, 2007), OCD patients as compared to controls were indeed more sensitive to physical disgust, as indicated by their scores on the DS. Patients were also more concerned about committing sociomoral transgressions themselves, as indexed by PIOS scores, and judged moral and conventional transgressions carried out by others to be more wrong. Moreover, patients reported that they would feel more “sick to their stomach” in response to transgressions than did controls. In sum, the behavioural results suggest that individuals with OCD are indeed hypersensitive to both physical disgust and sociomoral transgressions. These two sensitivities also appear to be related to one another: DS scores were positively correlated with PIOS scores, wrongness judgements and “sick to stomach” ratings, particularly for the moral transgressions. One caveat is that sociomoral judgement and emotion did not differ consistently between OCD patients with primary washing symptoms—in whom physical disgust concerns are presumably most elevated—and those with other primary symptoms. However, the sample sizes for these comparisons were quite small, and the primary symptom measure that was available may not precisely measure the severity of symptoms in various domains. Indeed, DS scores did not differ significantly between patients with primary washing concerns and those with primary checking concerns. Future work is thus needed to clarify the relationship between sociomoral hypersensitivity and specific types of OCD symptoms.

Experiment 4 also sought to investigate the moral/conventional distinction in relation to OCD. In particular, I was interested in whether OCD might have a differential impact on emotion and judgement in these two domains. The analyses yielded mixed results. On the one hand, patients rated both moral and conventional transgressions as more wrong than did controls, with no interaction. There was also no apparent tendency for patients to “moralize” conventional transgressions: like the controls, most patients viewed the wrongness of conventional transgressions as being dependent on authority, and that of moral transgressions as being independent of authority. On the other hand, there was a near-significant interaction between group and scenario type for ratings of “sick to stomach”, with patients reporting an especially
strong reaction to the moral transgressions. Thus, there may be a dissociation between the effects of OCD on judgement—which is impacted equally across morality and social convention—and on emotion—which may be more strongly impacted in the moral domain.

The neuroimaging results provide complementary evidence for a relationship between physical disgust and sociomoral judgement, and also shed light on the differences between patients and controls. In both controls and patients, activation of anterior insula was seen in response to moral and conventional transgressions. Anterior insula activation was also seen in response to physical disgust as compared to neutral photographs, and a conjunction analysis confirmed that this activation overlapped with the activations related to sociomoral judgment. This common neural substrate suggests that sociomoral judgement calls on affective processes that are also involved in the experience of physical disgust.

Comparison of patients and controls also revealed differences in the insula. Specifically, patients showed higher activation in middle and posterior insular regions in response to both the moral and conventional transgressions, as compared to controls. These differences occurred in regions that were distinct from the more anterior insular regions associated with physical disgust, and accordingly it is difficult to say whether they might reflect differences in the neural substrates of physical disgust processing. One possibility is that more posterior insular regions may support a different kind of physical disgust than that tapped by our localizer task. As mentioned, recent work has shown that different types of physical disgust may activate distinct regions of insula, with disgust triggered by food-related stimuli represented in more anterior regions, and disgust triggered by blood and injury represented more posteriorly (Harrison et al., 2010). These differences may be related to the distinct profiles of bodily responses associated with the two types of disgust: food-related disgust was found to be more related to changes in gastric activity, while injury-related disgust was associated with cardiovascular changes. The photographs used in our physical disgust localizer task consisted largely of images of disease and contamination, which may be more similar to food-related disgust than injury-related disgust. Thus, heightened activation in patients in more posterior insular regions could reflect differences in affective processes more similar to those engaged by injury-related disgust.

Taken together, the results of Experiment 4 are consistent with a relationship between physical disgust and sociomoral judgement and emotion. A population of individuals with pathologically
heightened disgust demonstrated systematic changes in sociomoral judgement and emotion, and also showed heightened brain activation in regions related to certain types of physical disgust. However, as mentioned, a limitation of this experiment is the inability to link sociomoral hypersensitivity specifically to washing-related OCD, which would be a stronger proof of relationship between physical disgust and sociomoral judgement. Experiment 5 was therefore designed as an additional test of the relationship between variation in physical disgust sensitivity and variation in sociomoral judgement and emotion. In Experiment 5, I examined physical disgust sensitivity in healthy undergraduates by selecting individuals who scored high and low on the DS. To enable a test of the specificity of physical disgust effects, I also included a measure of trait anxiety.

3.2 Experiment 5

Participants

In order to recruit high- and low-DS participants, mass screening was performed. Students in the introductory psychology class completed a shortened (8-item) version of the DS. Forty-two participants who scored in the bottom or top quarter of the sample took part in the study for course credit or $10. Computer problems occurred for two participants, for a final sample size of 40 (25 female, 1 unreported).

Measures

Participants completed the DS as well as the Multidimensional Anxiety Questionnaire (MAQ) as a measure of anxiety. The MAQ is a 40-item self-report measure of DSM-IV symptoms of trait anxiety and has been shown to have good psychometric properties (Reynolds, 2003).

Procedure

The moral judgement task used the same moral, conventional and neutral scenarios as in Experiment 4. Participants first read each scenario, then rated the action described on wrongness (1-9 scale: “not at all” to “extremely”) and permissibility (“allowed” or “not allowed”). If they judged that the action was not allowed, they made a judgement of authority-dependence (“ok if principal said so” or “not ok even if principal said so”). Participants then rated how they would feel if they observed the action on 1-9 scales, first using verbal labels (good/bad, sick to stomach,
angry) and then by endorsing facial expressions (disgust, anger, contempt, sadness, surprise, happiness and fear).

After completing the moral judgement task, the DS and MAQ were administered.

**Results**

1. **DS groups**

Examination of the DS score revealed a clear bimodal distribution. I therefore split the sample into two groups at 16, the typical DS mean for adults (Haidt et al., 1994). Descriptive statistics for the high- and low-DS groups are given in Table 17.

Table 17. Descriptive statistics for the high- and low-DS groups in Experiment 5.

<table>
<thead>
<tr>
<th></th>
<th>Low-DS</th>
<th>High DS</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Gender composition</td>
<td>9M, 8F</td>
<td>5M, 18F</td>
</tr>
<tr>
<td>DS Mean (sd)</td>
<td>10.3 (3.0)</td>
<td>24.5 (3.7)</td>
</tr>
<tr>
<td>DS Minimum</td>
<td>2.5</td>
<td>16</td>
</tr>
<tr>
<td>DS Maximum</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>MAQ Mean (sd)</td>
<td>65.9 (10.2)</td>
<td>78.5 (16.3)</td>
</tr>
</tbody>
</table>

2. **Sociomoral judgement**

The effect of DS group on wrongness judgements was analyzed with a mixed-measures ANOVA with factors of DS group (high/low) and scenario type (moral/conventional/neutral). As shown in Figure 13, this analysis revealed main effects of scenario type ($F[2,76] = 577.2, p < 0.001$) and group ($F[1,38] = 14.5, p < 0.001$), qualified by a type x group interaction ($F[2,76] = 6.00, p < 0.004$). High-DS participants rated both moral and conventional transgressions as more wrong than low-DS participants (moral: $t[38] = 3.66, p = 0.001$; conventional: $t[38] = 3.29, p = 0.002$). Interestingly, high-DS also rated the neutral scenarios as slightly more wrong ($t[38] = 2.2, p = 0.033$).
Permissibility judgements (allowed/not allowed) were examined by summing the number of “not allowed” responses for each participant by scenario type, then dividing by 16 to calculate the proportion of actions deemed not permissible. These proportions were subjected to a mixed-measures ANOVA with the same factors as before. This analysis showed a main effect of scenario type ($F[2, 74] = 332.1, p < 0.001$), but no effect of DS group and no interaction ($F$'s < 1; Figure 14). High- and low-DS participants thus did not differ in the somewhat more coarse judgement of whether an action was permissible or not permissible.
Figure 14. Permissibility judgements from participants in Experiment 5, showing the proportion of scenarios judged to be “not allowed”. Error bars give +1 SEM.

Judgements of authority-dependence are concerned with whether, given that a transgression was judged to be impermissible, the action would be “ok” if the principal of the school said it was ok. I was especially interested in reversals of judgement (i.e., it would be ok if the principal said so), because such reversals suggest that the wrongness of the transgression depends on external rules or authority. To examine authority-dependence, I calculated the proportion of judgement reversals made by each participant. Since only a negligible number of neutral scenarios were judged to be impermissible, I focused on moral and conventional transgressions. An ANOVA revealed significant main effects of transgression type (F[1,37] = 219.3, p < 0.001) and DS group (F[1,37] = 6.69, p = 0.014), as well as a marginally significant interaction (F[1,37] = 2.49, p = 0.123). As shown in Figure 15, moral transgressions were less likely to be perceived as dependent on authority compared to conventional transgressions, a result that is consistent with moral domain theory (Turiel et al., 1987). As well, low-DS participants perceived the transgressions to be more dependent on authority than did high-DS participants. The marginal interaction suggests that this effect is particularly pronounced for conventional transgressions. Indeed, the high- and low-DS groups differed significantly in their authority-dependence judgements for conventional transgressions (t[37] = 2.51, p = 0.016), but not for moral transgressions (t[38] = 1.29, p = 0.205).
3. **Moral emotion: Expression endorsement**

To examine emotional responses to the scenarios, I first conducted an omnibus 3 (Type) x 7 (Emotion) x 2 (DS group) mixed-measures ANOVA. This analysis showed main effects of emotion ($F_{[6, 228]} = 16.1, p < 0.001$) and DS group ($F_{[1,38]} = 5.36, p = 0.026$). Each of the two-way interactions was also significant: emotion x type ($F_{[12, 456]} = 56.3, p < 0.001$), emotion x group ($F_{[228]} = 5.89, p < 0.001$), and type x group ($F_{[2,76]} = 12.4, p < 0.00$). The three-way interaction was not significant ($F < 1$). Figure 16 shows the effects of group and type for each emotion. Given the significant interactions, I next computed separate ANOVAs for each emotion. Test statistics for these analyses are given in Table 18.

Figure 15. Proportion of transgressions judged to be authority-dependent in Experiment 5.
Figure 16. Emotion ratings derived from expression endorsement for the different scenarios in Experiment 5. Although scenario type is not a continuous variable, line graphs are shown for easier visualization. Higher values on the y-axis indicate greater endorsement of an emotional facial expression.
Table 18. Test statistics for emotion ratings in Experiment 5.

<table>
<thead>
<tr>
<th></th>
<th>Main effect: Type df = 2,76</th>
<th>Main effect: Group df = 1,38</th>
<th>Interaction df = 2,76</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disgust</td>
<td>F = 77.2</td>
<td>F = 5.94</td>
<td>F = 1.52</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001 *</td>
<td>p = 0.02 *</td>
<td>ns</td>
</tr>
<tr>
<td>Anger</td>
<td>F = 180.1</td>
<td>F = 7.94</td>
<td>F = 4.69</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001 *</td>
<td>p = 0.008 *</td>
<td>p = 0.012 *</td>
</tr>
<tr>
<td>Contempt</td>
<td>F = 4.57</td>
<td>F = 0.057</td>
<td>F = 0.999</td>
</tr>
<tr>
<td></td>
<td>p = 0.013 *</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>Sadness</td>
<td>F = 72.8</td>
<td>F = 8.68</td>
<td>F = 5.37</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001 *</td>
<td>p = 0.005 *</td>
<td>p = 0.007 *</td>
</tr>
<tr>
<td>Fear</td>
<td>F = 108.8</td>
<td>F = 8.15</td>
<td>F = 9.09</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001 *</td>
<td>p = 0.007 *</td>
<td>p &lt; 0.001 *</td>
</tr>
<tr>
<td>Surprise</td>
<td>F = 152.4</td>
<td>F = 8.24</td>
<td>F = 10.2</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001 *</td>
<td>p = 0.001 *</td>
<td>p = 0.003 *</td>
</tr>
<tr>
<td>Happiness</td>
<td>F = 45.9</td>
<td>F = 0.397</td>
<td>F = 0.148</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001 *</td>
<td>ns</td>
<td>ns</td>
</tr>
</tbody>
</table>

a. Emotional responses to moral vs. conventional transgressions

Examination of Figure 16 shows that for most of the emotions (disgust, anger, sadness, fear and surprise), moral transgressions resulted in stronger emotion endorsement than conventional transgressions. Happiness showed the reverse pattern. It is noteworthy that both moral and conventional transgressions elicited significantly more disgust than neutral scenarios (collapsing across high and low-DS groups, moral vs. neutral: t[39] = 12.1, p < 0.001; conventional vs. neutral: t[29] = 6.57, p < 0.001). In other words, both moral and conventional transgressions evoked disgust.

One notable exception to the pattern of stronger negative emotion endorsement for moral vs. conventional transgressions is contempt, where endorsement was higher for conventional transgressions relative to moral transgressions (t[39] = 2.89, p = 0.007). Indeed, contempt
endorsement for moral transgressions did not differ significantly from endorsement for neutral actions ($t < 1$). Also interesting is that contempt endorsement in the neutral condition was significantly higher than endorsement of the other negative emotions and surprise in the neutral condition ($t[39] = 4.35, p < 0.001$). Thus, contempt may not be strongly influenced by the valence of the action in question.

b. Effects of DS group

Figure 16 shows little difference between DS groups for two emotions: contempt and happiness. Indeed, effects of group and interactions were non-significant for these emotions (Table 18). By contrast, for all of the other emotions (disgust, anger, sadness, fear, and surprise), the high-DS group endorsed stronger emotions than the low-DS group, frequently qualified by an interaction in which this effect was strongest for the moral transgressions (Table 18).

4. Moral emotion: Verbal ratings

Separate ANOVAs were conducted to examine verbal ratings of valence, anger and “sick to stomach” (STS); test statistics are given in Table 19. As in the ratings made by endorsing emotional expressions, two questions were of interest: the pattern of ratings across moral and conventional transgressions, and the effects of DS group.

a. Moral vs. conventional transgressions

As shown in Figure 17, the pattern of verbal ratings of anger and STS resembled the ratings of anger and disgust made by endorsing emotional expressions, with moral transgressions receiving stronger endorsements than conventional transgressions. In particular, ratings of STS were much more similar to disgust expression ratings than to contempt expression ratings. As for the expression ratings, both moral and conventional transgressions elicited significantly higher STS ratings than neutral actions (collapsing across high- and low-DS groups: moral vs. neutral, $t[39] = 18.7, p < 0.001$; conventional vs. neutral, $t[39] = 5.76, p < 0.001$).
b. Effects of disgust sensitivity

Again similar to the expression endorsement results, high-DS participants made higher ratings of anger and STS than low-DS participants, and also rated the scenarios as more generally negative in valence (Figure 17).

![Figure 17. Verbal emotion ratings of the scenarios in Experiment 5.](image)

Table 19. Test statistics for verbal emotion ratings in Experiment 5.

<table>
<thead>
<tr>
<th></th>
<th>Main effect: Type df = 2,76</th>
<th>Main effect: Group df = 1,38</th>
<th>Interaction df = 2,76</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valence</td>
<td>F = 130.1</td>
<td>F = 3.71</td>
<td>F = 1.29</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001 *</td>
<td>p = 0.003 *</td>
<td>ns</td>
</tr>
<tr>
<td>Anger</td>
<td>F = 385.3</td>
<td>F = 9.70</td>
<td>F = 4.08</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001 *</td>
<td>p = 0.004 *</td>
<td>p &lt; 0.001 *</td>
</tr>
<tr>
<td>Sick to stomach</td>
<td>F = 323.6</td>
<td>F = 18.1</td>
<td>F = 10.9</td>
</tr>
<tr>
<td></td>
<td>p &lt; 0.001 *</td>
<td>p &lt; 0.001 *</td>
<td>p &lt; 0.001 *</td>
</tr>
</tbody>
</table>

5. Multidimensional Anxiety Questionnaire and the specificity of DS effects

The above analyses suggest a number of differences between high- and low-DS groups, both in sociomoral judgements and emotional responses. However, it is possible that these effects are not specifically due to disgust sensitivity, but rather to other variables with which disgust
sensitivity may be correlated. Because of this concern, I examined another measure of negative affectivity, namely scores on the Multidimensional Anxiety Questionnaire (MAQ).

Examination of the MAQ scores revealed one outlier with a score 3.2 sd above the sample mean. This individual was removed from subsequent analyses. For the remaining participants, there was a positive correlation between scores on the MAQ and DS ($r = 0.367$, $p = 0.020$), consistent with past work that found a relationship between disgust sensitivity and neuroticism (Haidt et al., 1994). Given this correlation, it is not surprising that MAQ scores were also significantly higher in the high- compared to the low-DS group ($\bar{x}_{\text{High-DS}} = 65.9$; $\bar{x}_{\text{Low-DS}} = 76.5$; $t_{[38]} = 2.67$, $p = 0.011$; Table 17). Thus, the concern that DS effects could be due to heightened anxiety is not unfounded. To address this concern, I repeated key analyses using MAQ scores as an additional predictor.

Figure 18 shows that in contrast to the DS scores, MAQ scores did not show a clear bimodal distribution. Therefore, a grouping approach (dividing the sample into high- and low-MAQ subgroups) may lack sensitivity. Accordingly, I examined the relationships between MAQ, DS, moral judgement and moral emotion using regression. To reduce the number of regression analyses needed, I focused on reactions to the moral and conventional transgressions, and on the emotions of disgust, anger and contempt assessed through facial expression endorsement.

Figure 18. Distribution of MAQ scores in Experiment 5.
a. Wrongness ratings

To examine the independent contributions of the MAQ and DS to wrongness ratings, I performed a regression in which MAQ and DS scores were entered simultaneously as predictors of wrongness. For moral transgressions, the regression coefficient for DS was positive and significant (partial r = 0.416, p = 0.009), while the coefficient for MAQ was not (partial r = 0.150, p = 0.369). Similarly, for conventional transgressions, the coefficient for DS was positive and significant (partial r = 0.491, p = 0.002), while the coefficient for MAQ was not (partial r = 0.036, p = 0.832). Thus, the DS, but not the MAQ, explained unique variance in wrongness ratings.

b. Authority dependence

Given that differences in DS scores only affected authority dependence ratings for the conventional transgressions, I examined the effect of MAQ scores only on the conventional transgressions. A regression showed that scores on both the DS (r = -0.283, p = 0.090) and MAQ (r = -0.434, p = 0.034) were positive and independent predictors of authority-dependence judgements.

c. Emotion endorsements

Emotion endorsements were analysed using similar regressions. As shown in Table 20, these regressions revealed a pattern that differed from the wrongness ratings. Specifically, the MAQ was the strongest predictor of both disgust and anger endorsement. This pattern was strongest for the moral transgressions. Neither the DS or the MAQ was a significant predictor of contempt endorsement.
Table 20. Regression analyses examining the relationship between DS, MAQ and emotion ratings in Experiment 5. Partial correlations are shown.

<table>
<thead>
<tr>
<th></th>
<th>Moral transgressions</th>
<th>Conventional transgressions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disgust endorsement</strong></td>
<td>DS ( r = 0.050, p = 0.764 )</td>
<td>DS ( r = 0.252, p = 0.128 )</td>
</tr>
<tr>
<td></td>
<td>MAQ ( r = 0.288, p = 0.079 )</td>
<td>MAQ ( r = 0.313, p = 0.056 )</td>
</tr>
<tr>
<td><strong>Anger endorsement</strong></td>
<td>DS ( r = 0.231, p = 0.164 )</td>
<td>DS ( r = 0.171, p = 0.304 )</td>
</tr>
<tr>
<td></td>
<td>MAQ ( r = 0.268, p = 0.103 )</td>
<td>MAQ ( r = 0.314, p = 0.055 )</td>
</tr>
<tr>
<td><strong>Contempt endorsement</strong></td>
<td>DS ( r = 0.037, p = 0.827 )</td>
<td>DS ( r = -0.098, p = 0.558 )</td>
</tr>
<tr>
<td></td>
<td>MAQ ( r = 0.066, p = 0.396 )</td>
<td>MAQ ( r = 0.102, p = 0.617 )</td>
</tr>
</tbody>
</table>

**Discussion**

Experiment 5 was designed to examine sociomoral judgement and emotion in a population of undergraduates high and low in physical disgust sensitivity. On the judgement side, high-DS individuals rated both moral and conventional transgressions as more wrong than did low-DS individuals, and also showed a greater tendency to “moralize” conventional transgressions, viewing them as independent of authority. Neither of these effects was due to general negative affectivity, since DS scores predicted independent variability even when MAQ scores were controlled. Thus, variation in the tendency to experience physical disgust had a specific impact on sociomoral judgement. This result is consistent with and extends previous work showing that high-DS individuals make more severe moral judgements about hypothetical criminals, an effect that was not explained by trait anxiety or trait anger (Jones & Fitness, 2008). One past study (Horberg, Oveis, Keltner, & Cohen, 2009) did not find an association between disgust sensitivity and punishment judgements about “justice violations”, which included leaving small tips and returning library books late. However, a number of methodological differences could account for this contradictory result. For example, the justice violations used as stimuli are not clear-cut moral transgressions, and it is unclear whether they are conventional transgressions either (e.g., it may not be wrong to leave small tips for poor service). As well, these authors devised their own measure of disgust sensitivity, the validity of which is unknown. The current work is more similar to, and provides a replication of, the experiment in which criminal vignettes were used as stimuli (Jones & Fitness, 2008).
In the current research, high-DS individuals also had stronger negative emotional reactions to conventional and especially to moral transgressions. However, this effect was not specific to DS in two ways. First, the heightened emotional responses of the high-DS group were not limited to increased disgust: increases in anger, sadness, fear and surprise were also seen. Second, when the MAQ was included as a predictor, the DS did not explain any unique variance in emotion ratings. Thus, shared variance with the MAQ accounted for the zero-order effect of DS on emotion ratings. To my knowledge, the effects of disgust sensitivity on sociomoral emotion have not been investigated elsewhere.

This pattern of results presents something of a puzzle, since it shows that variability in a trait emotion measure—disgust sensitivity—affects sociomoral judgement, but apparently not by influencing emotional responses to the transgressions, as one might expect. One possible explanation is that disgust sensitivity may influence sociomoral judgement via a non-emotional third variable. For example, disgust sensitivity is associated with political conservatism (Inbar et al., 2009), social dominance orientation and right wing authoritarianism (Hodson & Costello, 2007), which in turn may affect sociomoral judgement without necessarily having a specific impact upon disgust feelings. Future work could examine whether disgust sensitivity has any influence over and above these potential mediators. Even a fully mediated relationship would raise interesting questions about the directionality of the relationship between disgust sensitivity and the mediator variables. For example, could heightened disgust sensitivity make people more conservative, perhaps by making them more likely to avoid others who disgust them (e.g. homosexuals), thereby never being exposed to alternative viewpoints? The reverse is also plausible: individuals who are conservative may simply tend to recruit disgust pathways to reinforce their existing viewpoints, and the regular activation of disgust circuitry could generalize to other, non-social forms of disgust. Developmental studies may be particularly helpful in addressing these questions, as it would be possible to examine the development of both disgust sensitivity and mediator variables to reveal ontogenetic pathways underlying the relationship between disgust and sociomoral judgement.

A final noteworthy result is that both moral and conventional transgressions elicited significant self-reports of disgust, as measured both through expression endorsement and “sick to stomach” ratings. These findings converge with the results of Experiment 3 to support the idea that sociomoral disgust is not limited to very specific types of transgressions. In particular, others
have suggested that disgust may be reserved for transgressions that contain direct reminders of physical disgust, or for violations of the “ethic of divinity”, which is concerned with spiritual purity and godliness (Rozin, Lowery et al., 1999). However, the moral and conventional transgressions presented here did not contain references to physical disgust stimuli such as blood or body products, nor were they obviously concerned with spiritual purity. The fact that these transgressions still elicited self-reports of disgust suggests that sociomoral disgust may be a more general response to violations of sociomoral principles.

A potential limitation of Experiment 5 is the gender imbalance between the high- and low-DS groups (Table 17). Specifically, the high-DS group contained disproportionately more females, which is not surprising given that females are on average more disgust sensitive than males (Haidt et al., 1994). It seems unlikely that gender effects could account for the results reported here, given past work showing few gender differences in moral and conventional reasoning (Smetana, Killen, & Turiel, 1991). Unfortunately, the small number of males in the high-DS group precluded a direct comparison of males and females in the current study, so gender effects remain a topic for future investigation.

3.3 Chapter Discussion

The experiments described in this chapter both provide support for a relationship between the tendency to experience physical disgust and sociomoral judgement and emotion. The association was clearest for sociomoral judgement: both OCD patients and high-disgust sensitivity undergraduates judged that sociomoral transgressions were more wrong than did healthy controls and low-disgust sensitivity undergraduates. Among the undergraduates, this effect was not explained by a general tendency toward negative, withdrawal-related affect, since disgust sensitivity predicted unique variance over and above any contribution of trait anxiety. Furthermore, the relationship between physical disgust and sociomoral judgement extended to the neural level: anterior insula was activated both by sociomoral judgements and by physical disgust photographs, while middle and posterior insula were among the regions showing heightened activation during sociomoral judgement in OCD patients relative to controls.

Not surprisingly, some differences emerged between OCD patients and high-DS undergraduates. For example, while high-DS undergraduates were more likely to “moralize” conventional transgressions than their low-DS peers, OCD patients did not show this tendency. Another
difference is that while OCD patients had a specific elevation in feeling “sick to stomach” in response to the transgressions, high-DS undergraduates showed a broad, non-specific increase in negative emotions. These differences are difficult to interpret at the moment, however, since there are methodological differences between the experiments conducted in the two populations.

In spite of the methodological differences, both studies point to an interesting dissociation between sociomoral judgement and emotion. In both studies, the group manipulation—OCD vs. controls or high vs. low-DS—did not affect sociomoral judgement and emotion equivalently. In Experiment 4, OCD patients had higher wrongness ratings for both moral and conventional transgressions; but “sick to stomach” ratings were disproportionally elevated for moral transgressions. Moreover, at the neural level, the heightened wrongness of moral transgressions did not translate into heightened activation of emotional brain regions in this condition. In Experiment 5, disgust sensitivity predicted unique variance in sociomoral judgements, but not in emotional responses. Taken together, these results point to a relationship between emotion, morality and social convention that while real, is not one-to-one. As such, they contradict claims that sociomoral judgement is driven primarily by emotional reactions to transgressions (Haidt, 2001; Greene & Haidt, 2002).
Chapter 4 Causal attributions and disgust

In Chapters 2 and 3, my goal was to investigate the involvement of disgust in sociomoral judgement and emotion. Chapter 2 provided evidence consistent with a role for disgust in morality by demonstrating that individuals who are subjected to moral transgressions make facial movements that are similar to those made in response to distasteful liquids and images of physical disgust stimuli. Chapter 3 provided converging evidence by showing that normal and pathological variation in the tendency to experience physical disgust are both associated with systematic changes in sociomoral judgement. In this chapter, I move beyond the general issue of whether disgust is involved in morality and social convention to consider a more specific question: what kinds of sociomoral transgressions elicit disgust?

In asking this question, I make three assumptions. First, I assume that not all transgressions will evoke disgust to the same extent; rather, transgressions vary in how much disgust they elicit. Second, I assume that this variability is not random, but instead is systematically related to underlying features of the transgression. Third, I assume that that the features that influence levels of disgust are at least partially distinct from those that influence levels of other emotions (anger, sadness etc.). The first assumption seems uncontroversial. The second and third assumptions will be tested in this chapter.

My attempt to uncover features that uniquely influence levels of disgust is motivated by a long tradition in affective psychology that views distinct emotions as unique functional adaptations (Darwin, 1872/1998; Plutchik, 1980; Frijda, 1988; Panksepp, 1998). On this view, different emotions serve to organize behaviour, cognition, motivation and physiology into an adaptive response to a particular type of environmental challenge or opportunity. For example, the “fight or flight” response associated with extreme fear is an adaptive response to a deadly threat; a different response is called for when faced with a loss and the sadness it causes (Plutchik, 1980).4

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4 Note that “adaptive” here is meant in the evolutionary sense, that is, beneficial over the long-term average, in the natural environment to which the organism is adapted (Cosmides, Tooby, Lewis, & Haviland-Jones, 2001). The emotional responses of particular individuals to particular situations are evidently not always adaptive, especially in the modern world.
Because of this connection between specific types of situations and the emotions that they elicit, different emotions are influenced by different factors. For example, the level of fear that an individual experiences may be influenced by the degree of threat they perceive, while sadness may be influenced by the magnitude of loss (Roseman, Antoniou, & Jose, 1996).

Applied to the sociomoral domain, this analysis suggests that different sociomoral emotions will also be influenced by different factors. What might those factors be? Two suggestions from the literature are that sociomoral disgust may be directed toward people who are overly selfish ("social parasites"; Curtis & Biran, 2001), or toward those who show a lack of normal human social motivation, such as lack of empathy, willingness to betray friends etc. (Rozin et al., 2000) Almost no research has been done to test these hypotheses, and what little does exist is not especially supportive. For example, responses to a crime that suggests a lack of normal empathy—i.e. a fraud targeting vulnerable individuals—were less strongly correlated with disgust sensitivity than were responses to a mundane burglary (Jones & Fitness, 2008). However, since this is the only evidence available to date, it is difficult to make a firm conclusion about these suggestions.

Another possibility is that transgressions that violate certain sociomoral codes may be especially likely to elicit disgust. As mentioned previously, one theory proposes that disgust may be evoked most strongly by violations of the “ethic of divinity”, a code concerned with the sacredness of God and the purity or degradation of the self and others (Shweder et al., 1997; Rozin, Lowery et al., 1999). Unfortunately, the materials that were used to test this hypothesis almost all describe physical disgust stimuli (e.g., eating rotten meat; Rozin, Lowery et al., 1999). It is therefore not surprising that they evoke disgust, but it is unclear whether this disgust is related to the sociomoral violation or the physical disgust stimulus. The emotions associated with two other sociomoral codes, the “ethic of community” (concerned with duty and hierarchy), and the “ethic of autonomy” (concerned with individual rights and freedoms; Shweder et al., 1997), have also been examined. Transgressions that violated these two codes evoked stronger reports of contempt and anger, respectively, than disgust (Rozin, Lowery et al., 1999). This study therefore does provide some information about what kinds of transgressions tend to evoke less sociomoral disgust, but does not clearly indicate what evokes more disgust.
To the best of my knowledge, this short survey exhausts what is known about the factors that influence levels of sociomoral disgust. In this chapter, I draw on the idea that emotions may serve as unique functional adaptations. This idea suggests that considering the function of sociomoral disgust may be helpful. In particular, physical disgust may serve to motivate avoidance of and withdrawal from potential contaminants (Rozin, Haidt et al., 1999). By contrast, anger appears to be associated with approach motivation (Carver & Harmon-Jones, 2009). In a social context, approach motivation may manifest as a desire to change the behaviour of the individual who caused the angry response (Fischer & Roseman, 2007).

If sociomoral disgust and sociomoral anger retain these opposing motivational tendencies, we can now ask what kind of transgressions may usefully be met with withdrawal vs. approach motivation. One variable that may be important in determining motivational direction is the causal stability of the behaviour. As the name implies, causal stability refers to how stable or permanent the cause of an event is (Weiner, 1996). If a cause is stable, then its effects will likely occur again. By contrast, the effects of an unstable cause are less likely to recur. To use an example given by Weiner (Weiner, Graham, & Reyna, 1997), if one is late to a meeting because of a traffic jam in a small town (presumably an unstable cause of lateness), there is no particular reason to believe one will be late in future. On the other hand, if traffic is a continual problem, as in Toronto (a stable cause), then if one does not adjust the starting time, one will always be late.

In a sociomoral context, Weiner and colleagues have shown an association between judgements of causal stability and decisions about how and why a transgression should be punished (Weiner et al., 1997). In particular, causal stability appears to be related to differences in utilitarian vs. retributive punishment. A utilitarian approach to punishment seeks to reduce the likelihood that the individual will transgress again in the future—that is, utilitarian punishment is related to deterrence. By contrast, a retributive approach seeks to avenge the transgression by making the transgressor suffer. Weiner and colleagues found that utilitarian punishment goals are more likely to be associated with unstable causes, since these are the ones whose causes (by definition) may or may not occur in future. Accordingly, transgressions due to unstable causes may be influenced by deterrence. By contrast, if the cause of a transgression is stable, then punishment is unlikely to have an effect on the likelihood of the behaviour, and retributive goals predominate.
Motivational direction appears to map quite neatly onto this framework. In particular, approach motivation, which is concerned with attaining desired future goals, may be associated with utilitarian, future-focused punishment and accordingly with unstable causality. Hence, approach-related anger may be associated with transgressions that are due to unstable causes (Fischer & Roseman, 2007). By contrast, if the cause of a transgression is stable—e.g. if the transgressor is a “bad seed”—then withdrawal and avoidance may be the best option, since efforts to change this individual’s behaviour will likely be futile. Thus, withdrawal motivation may be associated with stable causality and a retributive punishment goal, and disgust may be the relevant emotion.

To my knowledge, no previous work has examined the potential association between disgust and causal stability. For example, while Weiner and colleagues have examined causal stability in relation to punishment motivation (Graham, Weiner, & Zucker, 1997; Weiner et al., 1997), these authors have not assessed emotional responses. One study has examined whether a manipulation designed to promote stable or unstable causal attributions was associated with differences in emotional reactions (Miller, Burgoon, & Hall, 2007). This research found that individuals in the stable condition reported more negative affect when presented with sociomoral transgressions. However, self-reports of anger, disgust, fear and contempt were collapsed together, so this work does not provide any information about the trends for individual emotions. In another study, participants were less likely to attribute negative behaviour to an individual’s character (a stable cause) when they recalled an incident in which they felt anger, as compared to an incident in which they felt contempt (Fischer & Roseman, 2007). Disgust was not examined, however.

In this chapter, I present three experiments designed to test the hypothesized association between disgust and causal stability. Each of the experiments employed a scenario methodology, in which participants read vignettes describing moral transgressions committed by other people. Participants then rated how they would feel if they saw the transgression occur, and made judgements about the causes of the behaviour, including its causal stability. Participants also reported on their utilitarian or retributive punishment motivation. In Experiment 6, I employed a correlational approach by presenting scenarios with ambiguous causal stability, then testing for a relationship between perceived stability and self-reported emotion. In Experiment 7, I directly manipulated causal stability across scenarios and looked for differences in emotional responses. Finally, in Experiment 8 I made use of individual differences in the tendency to perceive moral
character as stable vs. unstable (Dweck & Leggett, 1988). I then examined whether variability on this measure is related to differences in self-reported emotions.

4.1 Experiment 6

Participants

Thirty-two undergraduate students (8 male) participated in the experiment for course credit.

Materials

Twelve scenarios were developed, describing moral transgressions carried out by a third party actor (e.g. theft, cheating, unprovoked physical harm; see Appendix 2 for a full list of scenarios). Scenarios were written in the first-person perspective: participants were described as either witnessing the transgression or hearing about it. In order to control for other dimensions of causal attribution that are known to affect emotion and judgement (Weiner, 1996), scenarios were constructed so that the transgressions would be attributed to causes that were internal to and controllable by the actor. However, no information pertinent to causal stability was provided; that is, the scenarios were ambiguous as to causal stability.

Method

Scenarios were presented one at a time using experimental software. After reading a scenario, participants were asked to rate how they would feel if the events described actually happened to them. Participants reported how much disgust, anger and contempt they would feel by endorsing a photograph of an emotional expression on a 1-9 scale. Written emotion labels were also provided with the photographs.

Participants next made a series of causal judgements, by rating the actor’s behaviour on locus (internal/external), controllability, and stability on 1-9 scales. Finally, participants made a moral judgement by indicating whether the actor should be held responsible for his/her actions and whether the action was wrong or not. If participants judged that the action was wrong, they rated how wrong the action was, to what degree the actor should be punished and to what extent their motivation to punish was driven by utilitarian motives (to reduce the likelihood of the individual repeating the transgression or to deter others) or retributive motives (to give the individual what
they deserved). Judgements of wrongness, punishment and utilitarian and retributive motives were made using 1-9 scales.

**Analysis**

Ratings across the 12 scenarios were averaged within participants. The relationship between different ratings was then assessed using Pearson correlations.

**Results**

1. **Manipulation check**

Table 21 gives descriptive statistics for the causality ratings. As expected, the scenarios received high ratings of internal locus and controllability: the mean for both ratings was well above the mid-point of the scale, and the range was relatively narrow. By contrast, stability ratings ranged across the full scale, with the mean close to 5 (the midpoint of the scale). Thus, the ambiguous stability of the scenarios had the desired effect of producing variation in stability ratings between participants. Table 21 also gives descriptive statistics for ratings of disgust, anger and contempt, showing acceptable variability in these measures.

Table 21. Descriptive statistics for causal attributions and emotion ratings in Experiment 6. For locus judgements, higher values indicate greater internal causality; for controllability judgements, higher values indicate greater controllability; and for stability judgements, higher values indicate more stability/permanence. For ratings of disgust, anger and contempt, higher values indicate stronger endorsement.

<table>
<thead>
<tr>
<th></th>
<th>Mean (sd)</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locus</td>
<td>6.6 (0.9)</td>
<td>4.6</td>
<td>8.25</td>
<td>3.7</td>
</tr>
<tr>
<td>Controllability</td>
<td>7.5 (0.9)</td>
<td>5.3</td>
<td>9.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Stability</td>
<td>5.3 (1.3)</td>
<td>2.3</td>
<td>7.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Anger</td>
<td>5.6 (1.2)</td>
<td>3.2</td>
<td>7.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Contempt</td>
<td>5.3 (1.7)</td>
<td>1.0</td>
<td>7.7</td>
<td>6.7</td>
</tr>
<tr>
<td>Disgust</td>
<td>6.2 (1.2)</td>
<td>3.4</td>
<td>8.0</td>
<td>4.6</td>
</tr>
</tbody>
</table>
2. Stability judgements and emotion ratings

To examine the relationship between stability judgements and emotion ratings, I performed correlations between ratings of stability and ratings of anger, disgust and contempt. Each of these correlations was non-significant (r’s < 0.15, p’s > 0.4). Examination of scatterplots did not suggest the presence of outliers that could mask a weak relationship.

I next examined the relationship between emotion ratings and judgements relating to wrongness and punishment. Consistent with previous experiments, I found a significant relationship between overall wrongness ratings and ratings of disgust (r = 0.520, p = 0.002), as well as a significant relationship between wrongness and anger (r = 0.479, p = 0.0006). There was no significant relationship between wrongness and contempt (r = -0.024, p = 0.895).

No emotion was significantly correlated with overall judgements about how severely the actor should be punished (r’s < 0.25, p’s > 0.10). There was one significant relationship between contempt and retributive motivation (r = 0.358, p = 0.044). Anger and disgust were not related to any punishment motivation (r’s < 0.2, p’s > 0.2).

Discussion

This experiment did not reveal the predicted association between disgust/stability and anger/instability. One possibility is that even though there was variability in both emotion ratings and stability judgements, the correlational approach was not sufficiently powerful to uncover a relationship. Experiment 7 was therefore designed to provide a stronger manipulation of stability by creating scenarios that were explicitly high and low in causal stability.

4.2 Experiment 7

Participants

Twenty-eight undergraduate students (7 male) participated in the experiment for course credit.

Materials

Six of the scenarios from Experiment 6 were modified to create stable and unstable versions (Appendix 2). In the stable versions, information was provided regarding the actor’s history,
reputation or other characteristics, so as to suggest that the current incident may not be a unique event. In the unstable versions, similar information was provided to suggest that the current incident was atypical or transitory. Two stimulus lists were created, each consisting of three stable and three unstable scenarios. Stable and unstable versions of the scenarios were swapped between lists. Thus, both lists contained the same transgressions, but were mirror images as to which transgressions were presented in stable and unstable form.

Methods

Participants were randomly assigned to receive List 1 or List 2. The experiment was conducted as in Experiment 6, except that locus judgements were not examined.

Results

1. Manipulation check

The stable versions of the scenarios were rated as more stable than the unstable versions ($\bar{x}_{\text{unstable}} = 6.63, \bar{x}_{\text{stable}} = 8.12; t[27] = 7.41, p < 0.001$). However, the stability manipulation did not affect overall wrongness ratings ($t < 1$): transgressions associated with stable and unstable causes were perceived as equally wrong. Punishment severity was also equivalent for stable and unstable scenarios, although there was a slight trend toward stronger punishment for the stable scenarios ($\bar{x}_{\text{stable}} = 6.37, \bar{x}_{\text{unstable}} = 6.04; t[27] = 1.47, p = 0.153$). Lastly, there was no difference between the punishment motivations associated with stable and unstable scenarios: both were equally associated with retributive and utilitarian motivations ($t$’s < 1). Differences did emerge on some attribution dimensions, however. Stable as compared to unstable scenarios were viewed as more controllable ($\bar{x}_{\text{stable}} = 7.67, \bar{x}_{\text{unstable}} = 7.21; t[27] = 2.62, p = 0.014$), and participants judged that the actors in stable compared to unstable scenarios should be held more responsible for their actions ($\bar{x}_{\text{stable}} = 8.29, \bar{x}_{\text{unstable}} = 7.79 \ 8.12; t[27] = 2.32, p = 0.028$).

2. Emotion ratings

To examine the relationship between stability judgements and emotion ratings, I performed a repeated-measures ANOVA with factors of stability (stable/unstable) and emotion (disgust/anger/contempt). This analysis revealed significant main effects of emotion ($F[2,54] = 11.9, p < 0.001$) and stability ($F[1,27] = 5.38, p = 0.028$), but no interaction ($F[2,54] = 1.40, p = ...
Figure 19 shows that stable scenarios tended to evoke stronger reports of all three emotions relative to unstable. Thus, contrary to my hypothesis, anger and disgust increased to the same degree in both the stable and unstable scenarios.

To determine whether any individual scenarios might show the hypothesized interaction (i.e. increasing disgust but not anger in the stable relative to the unstable condition), I examined the patterns of emotion ratings for each scenario. This exploratory approach did not reveal any evidence for the predicted interaction.

![Figure 19. Emotion endorsement for the stable and unstable scenarios in Experiment 7.](image)

**Discussion**

Experiment 7 also did not find a specific relationship between disgust/stability and anger/instability. Rather, stable scenarios elicited stronger reports of both anger and disgust.

In the last experiment of this chapter, I adopted an individual differences approach. In particular, I was interested in whether emotional responses to moral transgressions might differ between individuals who tend to view moral character as being a fixed, stable trait, and those who believe that it is malleable. Individuals who hold the former worldview are known as entity theorists, while those with the latter view are known as incremental theorists (Dweck & Leggett, 1988). The entity/incremental distinction is best known in the area of implicit theories of intelligence. According to this research, individuals who view intelligence as being something that can change and develop—i.e., incremental theorists—are more likely to set mastery goals and more likely to persist in the face of failure than entity theorists, who view intelligence as being a fixed trait, and
accordingly tend to see failure as indicating a permanent lack of intelligence. A measure of implicit theories of sociomoral character has also been developed (Chiu, Dweck, Tong, & Fu, 1997), and has been related to rights vs. duty-based conceptions of morality. Individuals who hold an entity theory of sociomoral character prefer duty-based moral beliefs that uphold the status quo, consistent with a fixed sociomoral order. By contrast, incremental theorists prefer rights-based sociomoral beliefs, which allow and guide social change (Chiu et al., 1997).

Applying the concept of entity and incremental theories to the current question, I hypothesized that entity theorists, with their fixed view of sociomoral character, might have a stronger withdrawal response to transgressors, since these individuals believe that it is unlikely that a transgressor might change their ways and behave better in future. Accordingly, entity theorists might report higher levels of disgust in response to moral transgressions, as compared to incremental theorists.

### 4.4 Experiment 8

*Participants*

In order to recruit participants who hold entity or incremental theories of sociomoral character, mass screening was performed. Students in the introductory psychology class completed a 3-item version of the Implicit Theories of Morality Questionnaire (Chiu et al., 1997). Forty-eight participants who scored in the bottom or top quarter of the sample took part in the study for course credit or $10. Computer problems occurred for four participants, for a final sample size of 44 (18 male).

*Measures*

The full Implicit Theories of Morality Questionnaire (ITQ) is an eight-item measure of the tendency to view moral character as fixed (reflecting an entity theory) vs. changeable (reflecting an incremental theory). Sample ITQ items include “There is not much that can be done to change a person’s moral traits” and “Whether a person is responsible and sincere or not is deeply ingrained in his or her personality. It cannot be changed very much.” Lower scores on the ITQ indicate a stronger entity theory, while higher scores indicate a stronger incremental theory.
Methods

Experiment 8 was largely identical to Experiment 6. Participants completed the full ITQ at the end of the experiment, to confirm their status as incremental or entity theorists.

Results

1. Implicit Theories Questionnaire

Scores on the ITQ spanned the full range from 8 (strong entity theorists) to 48 (strong incremental theorists), with a mean of 28.2 (sd = 10.7). In a first effort to examine the relationship between implicit theories and other variables, I divided the sample into high-entity (n = 20, \( \bar{x} = 19.6 \)) and high-incremental (n = 18, \( \bar{x} = 38.2 \)) groups, omitting six participants with intermediate scores.

2. Effects of implicit theories on emotions and causal attributions

Independent-samples t-tests conducted to examine self-reported disgust, anger and contempt did not reveal any differences between entity and incremental theorists (all t<1). The only causal attribution to differ between groups was locus: incremental theorists tended to view behaviours as being more due to external causes, while entity theorists viewed them as being more due to internal causes (t[36] = 2.41, p = 0.021). Wrongness and punishment-related variables did not differ between the groups.

In a second approach, I performed correlations between scores on the ITQ, emotions, causal attributions and wrongness/punishment judgements. Consistent with the t-tests, the only significant or near-significant correlation was with locus, which was negatively associated with ITQ scores (p = -0.343, p = 0.023). All other r values were less than 0.2.

4.5 Chapter Discussion

Experiments 6, 7 and 8 did not support the hypothesized association between disgust and stability on the one hand, and anger and instability on the other hand. I discuss three possible explanations for the results. One possibility is that my hypothesis could be correct, but the experiments that I conducted did not provide an adequate test. A second possibility is that some factor other than causal stability could differentially influence disgust and anger. Lastly,
sociomoral transgressions could evoke an undifferentiated mixture of negative emotions, in which case searching for factors that distinguish between different emotions may be a mistaken effort.

I first consider whether methodological issues might explain the null effects that I observed. One mundane possibility is that the scenarios could have been so emotionally arousing as to result in ceiling effects. While this is plausible for the stable scenarios in Experiment 7, the correlational approach used in Experiments 6 and 8 provides some protection against this possibility. Indeed, there was a good range of scores on key variables in these experiments, so ceiling effects seem unlikely.

A more subtle methodological issue may be related to motivational intensity. In particular, there is evidence that motivation decreases when attaining a goal seems impossible. For example, one study examined EEG asymmetry—an index of motivational direction—in response to a mock radio editorial proposing a tuition fee increase (Harmon Jones et al., 2003). A group of students who opposed the increase was examined: half of the students were given the opportunity to sign a petition aimed at preventing the increase, while the other half had no such opportunity. Students in the petition group showed greater left-frontal EEG asymmetry—associated with approach motivation—than those in the control group. These results suggest that motivation is stronger when individuals have some means of pursuing their goals (Harmon-Jones, 2003).

In the current experiments, participants had no opportunity to actually withdraw from or approach the hypothetical transgressors in order to pursue their goals. This may have weakened their approach and withdrawal motivation and the associated emotions, which could diminish any connection to judgements of causal stability. This limitation could be addressed in future research by allowing participants the opportunity to respond to transgressors before measuring emotional responses. It may also be informative to measure approach and withdrawal tendencies directly, which was not done in the current research.

If methodological limitations are not to blame for the lack of a relationship between emotions and causal stability, it may be that stability is simply not a key factor that differentially influences disgust and anger. A number of other factors could be involved. For example, the degree of personal control that an individual believes that they can exert on a transgressor’s behaviour may be important. If one has little potential for control—for example, if the
transgressor is a superior in one’s workplace—then withdrawal may be the best option, associated with disgust, while approach and anger may be better suited to transgressions carried out by a subordinate, or more generally someone who one has more control over.

Finally, although I argued at the beginning of this chapter that disgust and anger should be influenced by different factors, it could be that sociomoral transgressions actually elicit an undifferentiated mixture of negative emotions. On this view, it is some general property of sociomoral transgressions—such as their wrongness or aversiveness—that evokes anger, disgust, contempt and other negative emotions alike. Indeed, Experiment 6 showed that wrongness judgements were positively correlated with self-reported anger and disgust. An emotional response consisting of a mixture of negative emotions could be advantageous if it primes a number of possible responses to the transgression. Individuals would then be able to select strategically from these potential responses so as to respond adaptively to the situation. In other words, evoking a mixture of negative emotions may allow for behavioural flexibility in the aftermath of a transgression.

This idea also raises the possibility that an individual’s emotional response may evolve after a particular course of action has been selected, so as to support the behaviour in question. For example, imagine that a moral transgression by a co-worker initially evokes both anger and disgust. If the co-worker is a subordinate, then one may decide to confront them, which could enhance anger and reduce disgust so as to maintain approach motivation. By contrast, if the co-worker is a superior, then one may decide that indirect criticism or gossip is a better response. This decision may then enhance disgust and reduce anger to facilitate avoidant behaviour. Future research could examine this idea by allowing participants the opportunity to respond to a transgression and measuring emotion before and after the opportunity is presented.
Chapter 5 Summary and Conclusions

The overarching goal of the research presented here was to investigate disgust as a sociomoral emotion—that is, as part of the complex affective and cognitive response to sociomoral transgressions. One key aim of the work was to test whether sociomoral transgressions do indeed elicit disgust that is similar to more basic forms of disgust elicited by physical stimuli. Chapters 2 and 3 presented a series of studies designed to provide such a test. In Chapter 2, I showed that activation of the levator labii muscle region of the face is common to both basic forms of disgust evoked by unpleasant tastes and images of physical contamination and to the much more abstract disgust elicited by unfair treatment in an economic game. Chapter 3 aimed to provide converging evidence for the involvement of disgust in morality and social convention by demonstrating that populations with heightened physical disgust sensitivity also show parallel changes in sociomoral judgement and emotion.

A second aim of this research program was to investigate factors that may influence how much sociomoral disgust is evoked by a given transgression. Drawing upon ideas from appraisal and attribution theory, Chapter 4 examined whether variation in causal stability might differentially affect disgust and anger. Although this approach was not successful at disentangling disgust from anger, the experiments in Chapter 4 do provide converging evidence for disgust as a sociomoral emotion, since the transgressions that were presented consistently elicited strong ratings of disgust.

Taken together, the experiments presented here point to a number of conclusions: that disgust is indeed a distinct part of the emotional response to sociomoral transgressions; that sociomoral disgust is related to more basic kinds of disgust; and that sociomoral disgust is also related to sociomoral judgements. I discuss each of these points in turn.

Sociomoral disgust is a distinct emotion

A concern with much of the previous work on sociomoral disgust is that it has not always clearly differentiated between disgust and other negative emotions elicited by sociomoral transgressions (Nabi, 2002; Bloom, 2004; Oaten et al., 2009). Indeed, the experiments presented here generally found that transgressions elicited heightened anger and sadness as well as disgust. However, I
undertook a number of measures to ensure that sociomoral disgust is not just another emotion in disguise. In Chapter 2, I showed that *levator labii* activation was not predicted by other emotions, including sadness (Experiment 2), anger and contempt (Experiment 3). In Chapter 3, I showed that the effects of disgust sensitivity were not explained by trait anxiety (Experiment 5). Particularly noteworthy is that disgust was differentiated from contempt. In Experiment 3, contempt, unlike disgust, did not correlate with *levator labii* activation or track the unfairness of offers. In Experiment 5, contempt toward moral transgressions did not differ from contempt toward neutral scenarios, a pattern that was quite distinct from disgust. Thus, sociomoral disgust appears to be a distinct strand in the total affective response to transgressions.

*Sociomoral disgust is related to physical disgust*

One of the most interesting features of disgust is the sheer diversity of its elicitors, which seem to range all the way from very simple gustatory stimuli through to complex social phenomena (Rozin & Fallon, 1987; Rozin et al., 2000). However, other than a shared verbal label, there has previously been little evidence that the full range of disgusting stimuli actually trigger a related emotional response. Chapter 2 provides some of the first evidence that sociomoral disgust evokes a rejection impulse similar to physical disgust by demonstrating common facial motor activity in response to both emotions. As well, Chapter 3 showed that variation in sensitivity toward physical disgust predicted variation in sociomoral judgement. Since there is no *a priori* reason to expect that one’s feelings about cockroaches should predict one’s sociomoral judgements, this finding implies that sociomoral judgement must draw upon or activate the emotional processes involved in physical disgust.

Some investigators have taken a more extreme stance on the relationship between physical disgust and sociomoral judgement, proposing that disgust is reserved only for transgressions that are literally or conceptually linked to physical disgust. For example, it has been suggested that only gory murders, deviant sexual crimes and the like actually trigger disgust (Royzman & Sabini, 2001; Bloom, 2004; Oaten et al., 2009). Others have argued that more abstract violations of purity and sanctity are the primary trigger for sociomoral disgust (Shweder et al., 1997; Rozin, Lowery et al., 1999; Horberg et al., 2009). However, the work presented here suggests that a wider range of both moral and conventional transgressions can elicit disgust. Indeed, none of the transgressions used as stimuli in the current research contained reminders of physical disgust or
were conceptually related to purity norms, but they nonetheless evoked signs of disgust in self-report, facial expression and fMRI measures. Other studies have also used transgressions without physical disgust stimuli, and found evidence of increased disgust in response to transgressions (Zhong & Liljenquist, 2006; Jones & Fitness, 2008; Danovitch & Bloom, 2009), more severe moral judgements in response to evoked physical disgust (Wheatley & Haidt, 2005; Schnall, Haidt et al., 2008), and associations between physical disgust sensitivity and sociomoral cognition (Hodson & Costello, 2007; Jones & Fitness, 2008; Tybur et al., 2009). 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 (Wheatley & Haidt, 2005; Jones & Fitness, 2008; Schnall, Haidt et al., 2008). Thus, sociomoral disgust appears to be a fairly general response to violations of many types of sociomoral norms.

An open question that remains is the function of disgust in the sociomoral domain. Why is an emotional response with origins in the rejection of hazardous foods triggered by sociomoral wrongdoings? What does disgust do in the sociomoral domain? One widely held hypothesis is that sociomoral disgust may serve to promote withdrawal from and avoidance of transgressors (Rozin, Haidt et al., 1999), in contrast to approach-related anger (Carver & Harmon-Jones, 2009). Chapter 4 attempted to examine a variant of this hypothesis, but without success. The function of sociomoral disgust thus awaits further investigation.

Sociomoral disgust is related to sociomoral judgement

Several of the experiments presented here found relationships between sociomoral disgust and aspects of judgement. For example, disgust sensitivity was consistently correlated with wrongness judgements (Experiments 4 and 5), and disgust ratings were correlated with wrongness ratings (Experiments 4, 5, and 6). Moreover, highly disgust-sensitive undergraduates tended to moralize conventional transgressions, viewing them as more independent of authority than did their low disgust-sensitive counterparts (Experiment 5). These results point to an association between sociomoral emotion and sociomoral judgement. Such associations have been reported in other contexts (e.g. Greene et al., 2001; Wheatley & Haidt, 2005; Schnall, Haidt et al., 2008), and indeed the causal direction of the relationship between emotion and sociomoral judgement has attracted considerable interest. In particular, there has been much debate about whether emotion causes judgement (Haidt, 2001) or vice versa (Turiel, 2006; Huebner, Dwyer,
& Hauser, 2009). The data presented here suggest, on the one hand, that there must be some causal connection between emotion and judgement. On the other hand, the current results are also inconsistent with a simple unidirectional relationship between emotion and judgement, in either direction (emotion ⇒ judgement or judgement ⇒ emotion). In particular, group manipulations—OCD vs. controls and high vs. low DS—did not have identical effects on sociomoral judgement and emotion, as detailed in Chapter 3. Moreover, the fMRI data also point to a dissociation between emotion and judgement. Specifically, even though moral transgressions were judged to be more wrong, they did not elicit additional activation of emotional brain regions. Thus, while there must be at least a bidirectional relationship between emotion and judgement (emotion ⇔ judgement), it is likely that emotion and judgement are also influenced by distinct factors, allowing each to have unique variance.

Another topic explored in some of the studies presented here is the relationship between emotion and the moral/conventional distinction, an area that has received relatively little attention (but see Arsenio, Gold, & Adams, 2006). This issue was not the primary focus of the research, and as such the results are quite preliminary, but nevertheless they raise some interesting future directions. First is the relationship between emotion and the ability to make the moral/conventional distinction. This was touched upon in Chapter 3, with mixed results. On the one hand, OCD patients distinguished between moral and conventional transgressions in much the same way as did controls. On the other hand, high-DS undergraduates were more likely to moralize conventional transgressions than were low-DS undergraduates. Further investigation of the effects of heightened emotionality on the ability to distinguish between moral and conventional transgressions is thus warranted. Another interesting issue is the emotional response to moral and conventional transgressions, treated primarily in Experiment 5. With one exception—contempt—moral transgressions elicited stronger reports of emotion (including disgust) than did conventional transgressions. However, it is difficult to say whether this stronger emotional response is related to the moral vs. conventional nature of the transgressions, since moral transgressions were also more wrong than conventional transgressions. It is also worth noting that conventional transgressions still elicited significantly more disgust than neutral scenarios, suggesting that disgust may be a fairly general response to both moral and conventional transgressions. Future work could develop a set of moral and conventional transgressions matched on wrongness, to better investigate the relationship between emotion and
the moral/conventional distinction. Finally, as mentioned above, the fMRI results provide an intriguing window into the neural underpinnings of moral and conventional judgement. To my knowledge, this is the first neuroimaging study to have distinguished between moral and conventional transgressions. The results showed substantial overlap between moral and conventional processing, and as mentioned, it is interesting that moral transgressions did not elicit additional emotional processing. FMRI research thus seems well-positioned to provide deeper insight into human sociomoral experience and cognition.

Conclusion

As described in the introduction, the ability to detect and avoid toxins appears to be very ancient (Garcia et al., 1975). That the disgust system, with its ancient and critical adaptive function of rejecting toxic foods, should be brought to bear in the sociomoral sphere speaks to the vital importance of regulating social behavior for human beings. The research presented here suggests that the stimulus triggers for this rejection mechanism have shifted far from their chemical sensory origins to the sociomoral domain. In sum, Shakespeare’s colourful language in *Hamlet* may be less of a metaphor and more evidence of his compelling insight into the human condition—sociomoral transgressions do indeed seem to be among the things that are “rank and gross in nature”.

References


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Appendix 1: Scenarios used in Chapter 3

Moral, conventional and neutral scenarios used in Experiments 4 and 5.

Moral transgressions

A student steals a library book that other students need to pass an exam.

A student puts out her foot and trips up another student who is running down the hall.

One student pushes another student, who falls to the ground.

A female student slaps another girl in the face.

After school, a student throws a hard, icy snowball in another student's face.

One student laughs at another student who failed a math test, saying that he must be stupid.

A student makes fun of another student who is in a wheelchair, calling him a cripple.

A student punches another boy in the stomach.

In gym class, a student throws a basketball at the back of another student's head, hitting him.

A student writes racist graffiti on another student's locker.

A student makes fun of a girl who can't afford cool clothes.

A student jumps to the front of the line ahead of other student in the cafeteria.

One student tells all her friends about a secret that another student told her.

A student spreads nasty rumors about another student.

During lunch, a student enters a classroom and steals a teacher's purse from her desk.

A grade 12 student makes younger students give him their lunch money.
Conventional transgressions

A student asks the teacher a question in class without raising her hand first.

A student wears a baseball hat in class, although it's against the school rules.

A student doesn't stand when the school sings the national anthem during assembly.

A student stays home from school without permission from her parents.

A student writes his name on his desk.

A student sends text messages to her friends on her cell phone in class.

A student wears a t-shirt and jeans to school instead of the school uniform.

A student chews gum in class, although it's against the school rules.

A student rides his skateboard in the playground even though it's against the school rules.

A student does not hand her homework in on time.

A female student uses the boy's bathroom although it's against the school rules.

A student addresses his teacher by her first name.

A female student wears a miniskirt even though it's against the school dress code.

A student stands up and walks out of the classroom without permission in the middle of class.

A student wears rollerblades inside the school, although this is against the school rules.

A student walks into class 15 minutes after the bell.
Neutral scenarios

A student laughs and jokes with her friends while they walk down the hall during the lunch break.

A student sits down at a table in the library and reads.

One student forgot his lunch at home, so he borrows lunch money from his friends.

Two students work together on their chemistry homework.

Before school, a student locks his bike up outside of the school.

One student leaves a note for another student on her locker.

A student tells another student about a big fight she had with her boyfriend the night before.

A group of students are in the school play together. After class, they meet to practice their lines.

A student talks with his friends outside of the school before class starts for the day.

After school, a student reads a magazine while he waits for the bus home.

A student calls his friend after school and they make plans to watch a movie together.

A student forgot to bring his umbrella to school, so he runs home though the rain at the end of the day.

A student hangs up her coat in her locker before going to class.

A student asks the art teacher for some more paint to work on her project in art class.

Members of the hockey team practice bodychecking one another before they get to puck handling.

After school, two students play basketball together in the playground.
Appendix 2: Scenarios used in Chapter 4

Scenarios used in Experiments 6 and 8

You’re standing in line outside a nightclub on a Friday, waiting to get in. Just ahead of you, someone trips on the steps and stumbles into the person in front of them, a much bigger man in a leather jacket. The man in the leather jacket swears loudly and pushes the other person hard, causing him to fall on the steps again. One of the bouncers quickly wrestles the man in the leather jacket aside, while someone helps the who was pushed get back onto his feet.

You are having lunch with Jane, a new acquaintance who you haven’t known for very long. The table next to you finishes their meal before you, pays their bill, and leaves a tip for the waiter on the table. After you and Jane have finished your lunch and left the restaurant, Jane tells you that she stole the tip from the next table.

After working for days on a final term paper, you hand it in at your professor’s office. After handing it in, you run into another student who was also in the class, and you mention how happy you are to have that paper over with. She says that she didn’t find it so bad, because she paid a friend of hers to write her paper.

You are walking to work one day past a small Jewish synagogue in your neighborhood. You see that one of the windows is broken, and there is some graffiti on the door of the synagogue. A man outside is working to clean up the mess. You walk over to ask him what happened. He says that a group of teenagers were caught doing the damage the night before.

You are at an office party that is taking place at a bar. You step into the alley behind the bar to get some fresh air, and you find two of your co-workers, Steve and Karen, kissing passionately. Steve and Karen don’t see you, and you quickly step back into the bar. You know Steve’s girlfriend, who is a very kind friend of yours, and just the other day Steve told you what a great relationship he has with her, and how devastated he would be if she ever left him for someone else.

You hear on the radio about a traffic accident that happened near your home. The driver, who had been drinking, went straight through a red light and crashed into a schoolbus going through
the intersection. Fortunately, the children on the bus were not hurt.

At a party to celebrate the end of term, you run into a friend who you haven’t seen for a while. You know that he wrote an exam in a very important class a couple of days ago, and you ask him how it went. He says that this time, he wrote a number of answers on his hand, so he thinks he will probably do pretty well on the test.

A classmate of yours lands a summer job at a prestigious company that usually does not hire university students. When you ask her how she got the job, she says that she put job experience on her resume that she does not actually have.

Your roommate comes home one day with some nice Christmas gifts for her family. She explains that she found a wallet on the ground with $200 in it. The wallet had no ID in it, so she kept the money to spend on gifts.

You are driving along a highway and you see a big traffic jam on the other side of the road. Later, you hear that there was an accident. It seems to have been a case of road rage: a man forced another car off the highway after the other driver cut him off in traffic.

Your friend tells you that after buying something at a small, family-owned store, the cashier accidentally gave him $20 more in change than he was owed. Your friend says he was happy to get the extra money and didn’t plan on returning it.

On a Sunday evening, you are surprised to see your roommate watching TV at home, because you thought she was going to go to her grandmother’s house for dinner. She said that she didn’t feel like going, so she called her grandmother and said that she has to study for an exam. In fact, her exam was last week.
Scenarios used in Experiment 7

Scenario 1

Stable:

You're standing in line outside a nightclub on a Friday, waiting to get in. Just ahead of you, someone trips on the steps and stumbles into the person in front of them, a much bigger man in a leather jacket. The man in the leather jacket swears loudly and pushes the other person hard, causing him to fall on the steps again. One of the bouncers quickly wrestles the man in the leather jacket aside, while someone helps the person who was pushed get back onto his feet. He wasn't hurt, so the line continues to move forward. As you enter the club, another bouncer says that he recognizes the man in the leather jacket, and that he has a history of getting angry at the club.

Unstable:

You're standing in line outside a nightclub on a Friday, waiting to get in. Just ahead of you, someone trips on the steps and stumbles into the person in front of them, a much bigger man in a leather jacket. The man in the leather jacket swears loudly and pushes the other person hard, causing him to fall on the steps again. One of the bouncers quickly wrestles the man in the leather jacket aside, while someone helps the person who was pushed get back onto his feet. He wasn't hurt, so the line continues to move forward. As you enter the club, another bouncer says that he recognizes the man in the leather jacket, and although he often comes to the club, he has never seen him angry before.

Scenario 2

Stable:

You are having lunch with Jane, a new acquaintance who you haven't known for very long. The table next to you finishes their meal before you, pays their bill, and leaves a tip for the waiter on the table. After you and Jane have finished your lunch and left the restaurant, Jane tells you that she stole the tip from the next table. She adds that she often steals small things
for the thrill of it.

Unstable:

You are having lunch with Jane, a new acquaintance who you haven't known for very long. The table next to you finishes their meal before you, pays their bill, and leaves a tip for the waiter on the table. After and Jane have finished your lunch and left the restaurant, Jane tells you that she stole the tip from the next table. She adds that she has never stolen anything before.

Scenario 3

Stable:

After working for days on a final term paper, you hand it in at your professor's office. After handing it in, you run into another student who was also in the class, and you mention what a tough paper you thought it was. She says that she paid a friend of hers to write her paper. She adds that she always gets someone else to do her essays, since she's not a good writer and needs good grades to get into law school.

Unstable:

After working for days on a final term paper, you hand it in at your professor's office. After handing it in, you run into another student who was also in the class, and you mention what a tough paper you thought it was. She says that she paid a friend of hers to write her paper. She adds that she's never done so before, but this is her last semester and she was having a hard time with the workload.

Scenario 4

Stable:

You are walking to work one day past a small but beautiful Jewish synagogue in your neighborhood. You see that one of the windows is broken, and there is some ugly graffiti on the door of the synagogue. A man outside is working to clean up the mess. You walk over to ask him what happened. He says that a group of teenagers were caught doing the damage the
night before. The police told him that the teenagers are likely members of a local neo-Nazi group.

Unstable:

You are walking to work one day past a small but beautiful Jewish synagogue in your neighborhood. You see that one of the windows is broken, and there is some ugly graffiti on the door of the synagogue. A man outside is working to clean up the mess. You walk over to ask him what happened. He says that a group of teenagers were caught doing the damage the night before. The police said that they didn't think the kids were motivated by anti-Semitism: it was just a case of kids being wild.

**Scenario 5**

Stable:

You are at an office party that is taking place at a bar. You step into the alley behind the bar to get some fresh air, and you find into two of your co-workers, Steve and Karen, kissing passionately. Steve and Karen don't see you, and you quickly step back into the bar. You know Steve's girlfriend, who is a very kind friend of yours, and just the other day Steve told you what a great relationship he has with her, and how devastated he would be if she ever left him for someone else. Later you ask another co-worker a bit more about Steve's relationship with his girlfriend. Your co-worker says that Steve has a reputation for getting together with the "new girl" at office parties.

Unstable:

You are at an office party that is taking place at a bar. You step into the alley behind the bar to get some fresh air, and you find into two of your co-workers, Steve and Karen, kissing passionately. Steve and Karen don't see you, and you quickly step back into the bar. You know Steve's girlfriend, who is a very kind friend of yours, and just the other day Steve told you what a great relationship he has with her, and how devastated he would be if she ever left him for someone else. Later you ask another co-worker a bit more about Steve's relationship with his girlfriend. Your co-worker says that Steve has a reputation as a steady
guy, and that he was planning to propose to his girlfriend soon.

**Scenario 6**

**Stable:**

You hear on the radio about a traffic accident that happened near your home. The driver, who had been drinking, went straight through a red light and crashed into a schoolbus going through the intersection. Fortunately, the children on the bus were not hurt. When interviewed, the driver's neighbors said that the driver is a long-time alcoholic.

**Unstable:**

You hear on the radio about a traffic accident that happened near your home. The driver, who had been drinking, went straight through a red light and crashed into a schoolbus going through the intersection. Fortunately, the children on the bus were not hurt. When interviewed, the driver's neighbors said that the driver usually does not drink.