The Causality of Moral Judgments: New Insights into the Reasoning versus Intuition

Debate

by

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Abstract

During the cognitive revolution, moral judgment was seen as primarily caused by conscious language-based reasoning. At the start of the twenty-first century, a new science of morality arose, which suggested that automatic intuitions primarily cause moral judgments. More recent research has called into question the evidence for intuitive morality, supporting the possibility that conscious reasoning is critical for generating moral judgments. The aim of my dissertation is to examine the importance of intuition versus language-based reasoning for generating moral judgments. To do so, I tested a) whether interfering with the primary physiological component of disgust has causal consequences for moral judgments and b), in a split-brain patient, whether processes in the language-dominant left hemisphere are critical for generating moral judgments.

More specifically, I tested whether disgust is causally related to moral judgments. To do so, I pharmacologically inhibited disgust responses to moral infractions and examined effects on moral thinking. Findings demonstrated that the antiemetic ginger (*Zingiber officinale*), known to inhibit nausea, reduces feelings of disgust toward non-moral purity-offending stimuli (e.g., bodily fluids), providing evidence that disgust is causally rooted in physiological nausea (Study 1; Study 5 ruled out an alternative explanation for this effect). This same physiological experience was causally related to moral thinking: ginger reduced judgment severity toward purity-based moral violations (Study 3) and eliminated the tendency for people higher in bodily sensation awareness to make harsher moral judgments (Study 4). Effects were consistently restricted to moderately severe stimuli and to purity offending stimuli: ginger had no effects on harm-based judgments (Studies 2 and 6). Together, findings provide the first evidence that

disgust can be disrupted by an antiemetic and that doing so has consequences for purity-based moral judgments.

Next, I examined in split-brain patient J.W. whether the right hemisphere, preferential for processing an agent's intentions, can make typical moral judgments when informationally disconnected from the language-dominant left. I found that processes in the language dominant left hemisphere are not critical for the right hemisphere to generate adult-typical intent-based moral judgments (Study 7).

Overall, findings provide renewed support for the importance of intuitive processes in generating moral judgments.

Lay Summary

The aim of my dissertation is to examine whether moral judgment (i.e., the evaluation of something as morally bad or good) is rooted primarily in intuition (i.e., fast, automatic processes, such as but not limited to emotion) versus language-based reasoning. The extent to which moral judgment is determined by either of these psychological processes is debated in the field of moral psychology. To contribute to this line of inquiry, I examined a) whether blocking feelings of disgust alters moral judgments and b), whether processes in the disconnected language-dominant left hemisphere of a split-brain patient are critical for generating moral judgments. Overall, the studies herein provide renewed support for the importance of intuitive processes in generating moral judgments.

Preface

The research presented in this dissertation is the result of collaborations with Dr. Jessica Tracy, Dr. Kiley Hamlin, and Dr. Alan Kingstone. Under their supervision, I was responsible for the formulation of the research questions, design of the studies, statistical analyses of the data, and writing of manuscripts. All projects and associated methods were approved by the University of British Columbia's Behavioral Research Ethics Board (certificates H14-01480 and H07-01936).

Portions of Chapters 1 and 2 are under review. Steckler, C. M. & Tracy, J. L. (2017). The Physiological Basis of Psychological Disgust and Moral Judgments. For this paper, I formulated the research question, trained research assistants to collect the data, and conducted all statistical analyses under the supervision of Dr. Tracy; the manuscript was written by both authors.

Portions of Chapter 3 are under review. Steckler, C. M., Hamlin, J. K., Miller, M. B., King, D., Kingstone, A. (2017). Moral judgment by the disconnected left and right cerebral hemispheres: A split-brain investigation.

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Acknowledgements

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Chapter 1: Introduction

What are the underlying processes that give rise to humans' sense of right and wrong? Is moral judgment the result of conscious language-based reasoning processes whereby we rationally assess the moral issues at stake? Or is moral judgment the result of fast, intuitive, automatic processes such as (but not limited to) emotion? For a long time, the dominant view in moral psychology held that moral judgments are generated through conscious language-based reasoning (e.g., Kohlberg, 1969). From this perspective, if someone were asked to assign moral value to the act of murder, she might judge murder to be morally wrong and justify her response by saying that murder is unacceptable *because* people do not have the *right* to decide the fates of others. Proponents of this reasoning centric view, such as the influential developmental psychologist Kohlberg, concluded that this kind of linguistic reasoning actually causes one's judgments of moral right or wrong; that is, people deliberate over the relevant inputs, and determine moral wrongness on that basis. Kohlberg (1969) held views that were rooted in the moral philosophy of Kant, who asserted that it was only through conscious reasoning that universal moral principles could exist (1785/1959; see Denis, 2012). This Kantian view was in stark contrast to the moral philosopher David Hume, who saw a gap between moral principles and "cold" reasoning, a gap Hume thought was bridged by feelings of emotion. To Hume, sentiment was responsible for moral principles, for if something was not *cared about*, it was unlikely to be a principle at all (Hume, 1777/1965). In embracing Kant, Kohlberg (1969) rejected a Humean view of morality. Kohlberg further refined his own theory of rational morality by systematically studying moral reasoning across development in a manner inspired by Piaget.

Kohlberg presented his subjects with moral dilemmas, such as the Heinz dilemma, in which a man called Heinz must decide whether to steal some unaffordable drugs to save his

dying wife. Kohlberg studied how his subjects reasoned their way through the dilemmas, holding an implicit assumption that his subjects' reasoning was the cause of their judgments. From his studies, Kohlberg concluded that moral reasoning developed across the lifespan in distinct stages, each characterized by unique calculations for determining right and wrong. For example, while young children might reason that Heinz should steal the drugs because he will get into trouble if his wife dies, older individuals might reason using abstract principles, such as that the right to life trumps the right to property. Although Kohlberg's emphasis was on developmental changes in moral reasoning, he also drew conclusions about the underlying psychological mechanisms of moral judgment. In particular, Kohlberg saw moral thinking as inherently cognitive (i.e., non-affective), conscious, and language-based (Kohlberg, Levine, Hewer, 1983; see also Haidt, 2001).

As Kohlberg and others (e.g., Killen, 2007; Nucci, 1981; Turiel, 1983) have shown, people reason linguistically about morality: they make rational moral arguments that tend to become more sophisticated with age. Other researchers, however, have questioned whether the fact that people *can* provide verbal reasons for their moral judgments is sufficient evidence for the claim that these verbal reasons cause, rather than result from, those judgments (Haidt, 2001). That is, instead of linguistic reasoning being the primary cause of moral judgment, Haidt (2001) argues that most moral judgments result from intuitive processes that are typically rooted in emotion and that need not be conscious or language-based. The conscious reasons people do provide, Haidt suggests, tend to occur *after* an intuitive, automatic judgment has already been made, and may be more accurately seen as justifications for a moral judgment than a reasoned cause of it.

1.1 Hints That Reasoning May Not Cause Judgments

One of the first hints that conscious linguistic reasoning may be a consequence of judgment (and thus a *rationalization*) rather than a cause came from outside the field of moral psychology. In the 1970s, a group of social psychologists examined whether there might be circumstances under which people lack the ability to observe their own reasoning process and are instead aware only of its end result (Nisbett & Wilson, 1977). That is, just as people are unaware of how their brains compute visual information (the process) and know only the visual representations ultimately generated (i.e., they simply "see"), so too might they be unaware of higher order processes such as the reasons for their judgments. Instead, these researchers argued, people might be aware only of that resultant judgment. Any verbal reasoning provided would be, essentially, a best guess based on the contextual information the individual had access to, similar to how one might attempt to infer the reasons behind someone else's judgments (Nisbett & Wilson, 1977).

This idea was tested by examining whether people at times erroneously report the factors that influenced their judgments. Erroneous reporting of the reasons underlying a particular judgment would suggest that conscious linguistic reasoning was not causal of those judgments, because, presumably, if conscious linguistic reasons caused the judgments then participants would be conscious of those reasons and be able to accurately report them. In one experiment, participants were presented with pairs of nylon stockings arranged left to right and asked to choose which pair was of the highest quality. After making their choice, they were instructed to report why they had chosen the pair that they did. Unbeknownst to these participants, the four pairs of nylon stockings were identical. However, participants were four times more likely to select the rightmost pair relative to the leftmost pair, and offered incorrect but plausible sounding

reasons for this decision (such as that the texture was most appealing; Nisbett & Wilson, 1977; see also Greene, 2007).

To take another example, in a different study participants watched a film and made various ratings of it. Some participants watched the film while a distracting electric saw noise was produced in the hallway outside the room, and others watched the film without any distractions. After making their ratings, participants in the saw noise condition were asked if the distraction had affected their responses. Although the distraction had no measurable effect—the noise group and control group had nearly identical ratings—over half of the participants in the distraction group reported that the noise had affected their responses to the film (Nisbett & Wilson, 1977).

A second hint that reasoning may be a *post-hoc* affair came from studies of split-brain patients – individuals who have sustained partial or complete severing of the corpus callosum, the large bundle of neural fibers that informationally connect the two cerebral hemispheres. When experimenters presented a task or a manipulation to the right hemisphere only, leaving the left hemisphere entirely "out of the loop", the language centers of the left hemisphere nevertheless concocted plausible sounding stories to explain the behavior of the right hemisphere (Gazzaniga, Bogen, & Sperry, 1962). For example, a split-brain patient was presented different images to the left and right hemisphere and was asked to choose, with each hand (controlled by the contralateral hemisphere), images among a set that best matched the images seen. The patient's right hemisphere saw a snowy field and selected (with his left hand) a snow shovel as the matching image. The patient's left hemisphere saw a chicken foot and selected (with his right hand) a chicken as the matching image. When asked why his left hand was pointing to the shovel, his speaking left hemisphere, which had no access to the visual information shown to the

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right hemisphere, reasoned that the shovel was to clean out the chicken coop. That is, the verbal left hemisphere generated a seemingly plausible interpretation of the actions of the informationally disconnected right hemisphere. In fact, language processes in the left hemisphere so readily generate explanations for events occurring outside direct awareness that Gazzaniga (1985) developed the theory of the interpreter module largely on this basis. According to this theory, many mental operations are the result of several interacting modules working in parallel outside of conscious awareness, and the interpreter module functions to make sense of the evaluative and behavioral output of these modules (Funk & Gazzaniga, 2009; see also Haidt, 2001).

1.2   Reason, Emotion, and Judgment in the Moral Domain

Inspired by these findings and theorizing, Haidt (2001) applied them to moral thinking, and suggested that moral judgments are largely caused by fast and automatic intuitions, and these processes need not reach conscious awareness in order for judgments to be made. According to this view, if conscious linguistic reasoning about moral judgments does not cause those judgments—then it must be a consequence of them. One prediction from this view, then, is that if you remove people's ability to justify their judgments with plausible reasons, their moral judgments should not change. On the other hand, if conscious linguistic reasoning has a significant causal impact on moral judgments, then these judgments should be affected by people's ability (or lack thereof) to provide reasons for their judgments. Haidt tested these competing predictions by presenting participants with stories designed to make it difficult for participants to produce acceptable reasons for why the transgression is morally wrong. The most famous of these conveys a story in which a brother and sister decide to have sex (Haidt, 2001, p. 814):

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"Julie and Mark are brother and sister. They are traveling together in France on summer vacation from college. One night they are staying alone in a cabin near the beach. They decide that it would be interesting and fun if they tried making love. At the very least it would be a new experience for each of them. Julie was already taking birth control pills, but Mark uses a condom too, just to be safe. They both enjoy making love, but they decide not to do it again. They keep that night as a special secret, which makes them feel even closer to each other. What do you think about that? Was it OK for them to make love?"

This story was designed to make it difficult for participants to reason based on considerations of harm: the siblings used multiple forms of contraception so a harmful pregnancy was highly unlikely, the act was kept a secret so no one else would be harmed, and Mark and Julie are described as becoming closer as a result of the experience, so their relationship was not damaged. Despite the lack of plausible harmful reasons individuals could put forth when making their moral judgments, participants nonetheless generally said that it was not OK for Mark and Julie to engage in incest. Furthermore, participants' moral judgments rarely shifted even after being reminded that the acts they evaluated were completely harmless given the circumstances. When asked why they continued to condemn these acts, participants could not provide sufficient justifications, and instead said things along the lines of, incest is wrong because "it just is." Haidt called this phenomenon "moral dumfounding" (Haidt, Bjorklund, & Murphy, 2000; Haidt & Hersh, 2001). Because the participants inflexibly clung to their moral judgments without supporting linguistic rational reasons, moral dumfounding provided some of the first evidence to suggest that conscious linguistic reasoning does not have significant causal impact on at least some kinds of moral judgments. Instead, Haidt's work suggests that verbal reasons are *ex post*

facto rationalizations that seek to justify a conclusion that has already been drawn by other mental processes. What causes those judgments, Haidt argues, are automatic intuitions about the wrongness of incest that are fueled by irrational emotions – such as feelings of disgust (Haidt, 2001).

A second case of moral dumbfounding was documented around the same time, when researchers examined neural responses associated with moral judgments of the classic trolley dilemma. The dilemma, put forth by the philosophers Foot and Jarvis, is as follows. Imagine that a trolley is speeding down a track. On the track are five people who will be killed by the trolley if nothing is done. Near the track there is a switch that can be flipped that will divert the trolley onto another track. On this other track is a single person who will be killed by the trolley. Is it acceptable to flip the switch, killing the one person to save five? In a second version of the dilemma, a trolley is again speeding down a track. On the track, again, are five people who will be killed if no action is taken. Above the track there is a large person on a footbridge; the moral dilemma in this scenario is whether it is acceptable to push the person onto the track, again killing the one to stop the trolley in order to save the five.

In some ways, the two versions of the trolley problem seem identical: participants must grapple with whether it is morally acceptable to sacrifice one person in order to save the lives of five. And yet, responses diverge sharply between the two versions of the dilemma (Greene et al., 2001). While most people agree that it is morally acceptable to flip the switch, many say it is unacceptable to push the person onto the track. What is more, many participants are unable to provide reasons for their different judgments. Based on neuroimaging data, Greene and colleagues (2001) have suggested emotionally charged intuitions are activated by the thought of committing physical assault on one person in order to save five in the footbridge case. This

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emotionally charged intuition is thought to override people's otherwise typical tendency to prefer the utilitarian option of maximizing the greater good. That is, emotion-related parts of the brain become more activated by the footbridge case than in the switch case, and this difference predicts which moral decision people make.

But the overall conclusion of Greene's work is not so straightforward. This is because, on the one hand, Greene documented a case of moral dumbfounding and showed that emotional responses seem to be responsible, but on the other hand he showed through neuroimaging and behavioral data that people do seem to reason about the scenarios, particularly in the switch case. That is, they seem to engage in a utilitarian calculus about maximizing the greater good. Greene's work (and his dual process theory of moral judgment) thus suggested an important role for conscious reasoning in at least some kinds of moral evaluation tasks – but not in others (Greene et al., 2001; Greene & Haidt, 2002).

Greene's findings suggest an important caveat for this debate about the causal inputs to moral judgments: the most accurate answer is sure to be complex because psychological mechanisms do not reflect a simple 1-to-1 correspondence between a stimulus and a response. It is unlikely, then, that moral judgments are generated solely by intuitions or emotions, or solely by conscious language-based reasoning. So, although I am following the academic stereotype of bogging down the introduction of my dissertation with a caveat (Pinker, 2014), there is one important caveat about the research presented here. The caveat is that although the automatic intuition versus conscious language-based moral reasoning dichotomy is a convenient framework from which to think about the underlying psychological processes that cause moral judgment, the notion that moral judgment is either wholly caused by fast automatic processes or by slower conscious language-based reasoning processes is almost certainly a false oversimplification.

However, it is a useful oversimplification because the true complexity of a psychological phenomenon such as morality does not easily lend itself to targeted experimental study. The simplification allows one to parse the question down into a form from which testable hypotheses can be derived and through which empirical contributions can be made. We must keep in mind, though, when drawing conclusions from empirical studies that ultimately the question: "what are the underlying psychological processes that cause moral judgments?" is likely to have a complex answer with many interacting parts at different levels of analysis (e.g., genetic, cultural, developmental).

1.3 Disgust and Moral Judgment

After Haidt's (2001) article, and Greene's (2001) work, a flood of studies entered the literature providing supportive evidence that emotions – especially the emotion of disgust – play a critical role in moral judgments. The emotion of disgust was first studied by Darwin (1872), who saw it as an adaptive reaction people felt in response to potential sickness or contamination. This line of thinking, that disgust is a protective mechanism from potential contamination, has continued with more contemporary theorists. The motivations attributed to disgust are thought to lead to the rejection and/or avoidance of certain things that potentially contain harmful microorganisms, such as rotten meat or feces (Angyal, 1941). However, as mentioned previously, disgust is activated by more than potential contaminants – people also report being disgusted by things that presumably have nothing to do with preventing the ingestion of microorganisms – such as in response to moral violations or disliked outgroups, for example gay men (Pizarro, Detweiler-Bedell, & Bloom, 2006; Rozin, Haidt, & McCauley, 2000).

Indeed, numerous studies have documented a positive association between self-reported disgust and moral judgments, indicating that the more disgusted people feel when thinking about

a moral infraction, the worse they judge the infraction to be (Crawford, Inbar, & Maloney, 2014; Gutierrez & Giner-Sorolla, 2007; Inbar, Pizarro, & Bloom, 2012; Rozin, Lowery, Imada, & Haidt, 1999; Horberg et al., 2009; Inbar, Pizarro, Knobe, & Bloom, 2009; but see Kayyal, Pochedly, McCarthy, & Russel, 2015). For example, in a sample of American adults, disgust sensitivity (the extent to which one is prone to experiencing disgust) negatively predicted favorable attitudes toward groups that hold non-traditional views regarding sexual morality (e.g., pro-choice groups) and positively predicted favorable attitudes toward groups that support traditional sexual morality (e.g., conservative Christians; Crawford et al., 2014). Additionally, people from vastly different cultures commonly refer to moral violations as disgusting, suggesting that using the language of disgust in the moral domain may be a universal human tendency (Haidt, Rozin, McCauley, & Imada, 1997). Furthermore, other studies have yielded evidence that feelings of disgust actually play a causal role in moral judgments. In these studies, researchers typically place participants in a dirty room or in the presence of a noxious odor—eliciting disgust—then measure their judgments of a potential moral infraction (e.g., Eskine, Kacinik, & Prinz, 2011; Schnall, Haidt, Clore, & Jordan, 2008). Early results in this area of research generally converged to show that manipulated disgust increased the severity of subsequent judgments about an unrelated moral infraction; for example, smelling a noxious odor leads people to make harsher judgments of incest (Schnall et al., 2008).

The evidence that feelings such as disgust – an emotion people feel when they sense something repulsive, like feces – can have a causal impact on moral judgments, provided strong support for the notion that morality is not entirely rational: It is not rooted entirely in conscious linguistic reasoning. More recently however, much of the evidence supporting intuitive morality has been called into question. For example, some researchers have argued that although disgust

may be associated with thinking about acts that violate humans' sense of purity, these feelings are not causally related to judgments of moral wrongness. This argument comes from four lines of related evidence and theorizing.

1.4 Questioning the Role of Disgust in Moral Judgment

First, researchers have argued that because it is socially unacceptable to expose people to disgusting things, experimental manipulations that place people in disgusting situations create a norm violation, as well as arousing disgust. As a result of the experimenter violating a norm by exposing participants to noxious stimuli, participants may feel a sense of moral disapproval toward the experimenter, but channel it onto the task at hand, resulting in harsher moral judgments—but not as a result of feelings of disgust (Landy & Goodwin, 2015; Royzman, 2014). In other words, these studies may demonstrate that cognitive judgments of disapproval, and not disgust, increase moral judgment severity.

Second, these studies do not address the question of whether disgust that *spontaneously* arises as a result of thinking about a moral infraction is causally related to judgments of *that* infraction. This distinction may seem trivial, but testing it is in fact essential to establishing internal validity of the presumed causal link between spontaneously arising disgust associated with observing a moral infraction and judgments of that infraction. In the manipulated disgust studies, the disgust evoked is incidental to the moral infraction, yet an assumption is made that this incidental disgust experienced as a result of exposure to a noxious odor is the same psychological or physiological experience that occurs as a result of being exposed to a moral infraction. It is possible, however, that these two experiences differ in meaningful ways. For example, exposure to a noxious odor may elicit physical feelings of nausea, whereas reading about a moral infraction may elicit a more cognitive or psychological sense of wrongness, but

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not any literal nausea. Though both of these experiences may be called "disgusting", and the experience of one (malodorous-elicited disgust) may be causally related to the experience of the other (moral disgust), that does not mean that the same psychological or physiological experience is involved in both; nor does it tell us how people feel when they encounter a moral infraction in the absence of any other disgust-eliciting stimulus.

Third, a broader concern has been raised regarding the robustness of incidental disgust studies; a recent meta-analysis found a small ($d = .11$) effect of incidental disgust on moral judgments, but no effect when accounting for publication bias (Landy & Goodwin, 2015). However, this meta-analysis did not take into account a variable that may moderate the disgust-moral judgment link: awareness of one's own bodily sensations. Several researchers have argued that the effects of disgust on moral judgments are, and should be, particularly pronounced for individuals who are highly attuned to their bodily feelings, because it is awareness of one's embodied emotional experiences that influences moral thinking (Schnall et al., 2015). When feeling disgusted, those who more readily and consciously become aware of bodily feelings of nausea should have greater access to this affective state information, and therefore be more able to use it to inform their moral evaluations.

Fourth, several researchers have argued that disgust does not explain the cause of moral dumbfounding. Using Haidt's story of siblings committing incest, these researchers found no evidence that disgust sensitivity predicted responses (Royzman, Leeman, & Baron, 2009), and, instead, found that incest moralization was predicted by the amount of harm participants perceived to be caused (Gray, Schein, & Ward, 2014). These researchers argued that, despite participants being told that the acts were harmless in this fictional scenario, they were nonetheless unable to remove their prior beliefs about the real world and the real world

interpersonal harmfulness of incest (Royzman, Cassidy, & Baron, 2003). In support of this idea, Royzman, Kim, and Leeman (2015) conducted a new study in which they asked participants to evaluate whether the siblings would face real world harmful consequences despite the putatively harmlessness of the incestuous act. Overall, participants reported that despite the harmless context conveyed in the story, the siblings would face severe consequences. These findings suggest that condemning incest despite the apparent harmlessness of the story was an entirely rational response, given the assumed harmful effects of incest. These findings also suggest that the supposed moral dumbfounding effect was not due to an emotional "yuck" factor, but rather to rational reasoning about harm.

In fact, several researchers have called an emotionally driven intuitive morality into question by arguing that perceptions of harmfulness are the underlying cause of all moral judgments – not only toward those scenarios (e.g., incest) that have led to cases of moral dumfounding. These researchers suggest that perceptions of harm promote judgments of both moral wrongness and disgustingness even for acts that seem—at face value—harmless, such as same-sex marriage (Cameron, Lindquist, & Gray, 2015; Gray & Keeney, 2015; Gray, Young, & Waytz, 2012; Schein, Ritter, & Gray, 2016). For example, Schein and colleagues (2016) measured moral judgments, perceptions of harm, and feelings of disgust toward a variety of moral transgressions, and found that perceptions of harm fully mediated the link between feelings of disgust and judgments of a moral transgression's severity – even for putatively harmless acts. These findings suggest that rational assessments of harm may underlie any link between disgust feelings and moral judgments.

The idea that harm perceptions underlie all of morality stands in contrast to pluralist theories of morality, which see the moral sphere as broader, consisting of several distinct

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domains – each having different underlying psychological causes. Moral pluralist theories gained

traction through the work of the anthropologist Shweder (1990). From his studies of non-

Western societies, Shweder came to see morality as consisting of three distinct spheres: the ethic

of autonomy (encompassing issues of harm, justice, individual rights), the ethic of community

(encompassing issues of respect, hierarchy, and loyalty for the group), and the ethic of divinity

(encompassing issues of purity and sanctity). Early studies in this area found that each ethic was

associated most strongly with a different distinct emotion, suggesting that each concern was

driven by distinct psychological processes (Rozin et al., 1999). Expanding on this account of

moral pluralism, Haidt and Joseph (2004) also suggested that there are multiple moral domains –

even more than Shweder's three ethics (see also Graham et al., 2012). In their Moral Foundations

Theory, Haidt and colleagues propose that evolutionary selection pressures associated with social

living shaped multiple distinct mental modules that gave rise to multiple distinct domains of

morality. These evolved foundations interact with cultural learning to produce cultural variation

in the extent to which any single foundation is active in a given group of individuals. The

domains of Moral Foundations Theory include: care/harm, fairness/cheating, loyalty/betrayal,

authority/subversion, and sanctity (purity)/degradation (Graham et al., 2012; Haidt, 2012).

1.5 Is Disgust's Role in Moral Judgment Widespread or Does it Show Specificity?

There is a question in the field of moral psychology as to whether feelings of disgust

affect moral judgments only within the Moral Foundations Theory domain of purity/sanctity, or

whether disgust feelings are involved in morality more broadly, including the domain of harm

(Bloom, 2004). This debate is relevant to the larger debate on the causal inputs to moral

judgment; the answer to it may suggest that disgust-fueled intuitions provide causal input to

some kinds of moral judgments but not to others (though some view all moral judgments as

stemming from perceptions of harm, further complicating this debate; e.g., Schein, Ritter, & Gray, 2016). Experimental studies on this question of the extent to which disgust is causally related to a single domain or to multiple domains of moral judgment have produced mixed results. Some studies have found that incidental feelings of disgust increase the severity of moral judgments in the domains of both purity and harm (e.g., Chapman, Kim, Susskind, & Anderson, 2009; Schnall et al., 2008) whereas other studies find the effects of incidental disgust to be specific to the domain of purity (e.g., Horberg et al., 2009).

This issue is further complicated by the fact that several studies indicating that disgust's role in moral judgment extends beyond the domain of purity have been criticized on methodological grounds. For example, Chapman and colleagues (2009) used electromyography (EMG) to measure participants' facial expressions in response to receiving an unfair offer in the Ultimatum Game (in which a Proposer decides how much of a monetary windfall to give to a Responder), and found that people displayed disgust facial expressions upon receiving unfair offers, and the degree of activation of disgust-associated facial muscles positively predicted their rejection of Proposer offers (meaning they chose to punish the Proposer; rejecting an offer meant neither Proposer or participant Responder was able to keep any of the money). In response to these findings, however, Royzman and Kurzban (2011) have argued that showing disgust facial expressions in response to perceived moral transgressions may merely serve a signaling function (and thus not be causal of moral judgment), informing others that one understands and obeys moral norms (see also reply by Chapman & Anderson, 2011). The extent to which disgust affects moral judgments in one or several domains is therefore still an open question – not least because most studies examining the possibility of a causal disgust-moral judgment link do not specifically address this issue of whether disgust plays a causal role in all five moral domains

specifically. As is not uncommon in this area of inquiry, more research is needed to ascertain whether feelings of disgust provide causal input to moral judgments broadly speaking, or whether such feelings are restricted to judgments of certain kinds of moral violations.

In sum, a review of the prior literature suggests that although psychologists have debated for some time the question of whether disgust feelings are causally related to moral judgments (e.g., Bloom, 2004; Chapman & Anderson, 2013; Pizarro & Bloom, 2001; Haidt, 2001; Horberg, Oveis, Keltner, & Cohen, 2009; Huebner, Dwyer, & Hauser, 2009; Pizarro, Inbar, & Helion, 2011; Landy & Goodwin, 2015; Schnall, Haidt, Clore, & Jordan, 2015), the debate is far from resolved; it remains unclear whether feelings of disgust are causally related to judgments of moral infractions, and if so, which kinds of moral infractions.

This issue is compounded by the fact that studies also have yet to examine whether psychological feelings of disgust resulting from non-moral purity-violating stimuli (such as noxious odors or images of feces) are rooted in physiological feelings of nausea. Although people use words like "repulsion" and "sick" to describe their disgust feelings (e.g., Royzman, Leeman, & Sabini, 2008), studies have not experimentally tested whether the emotional experience of disgust actually includes a nausea physiological component. Decades ago, Angyal (1941) posited that "the most marked vegetative component of disgust is a tendency to vomit ('turning of the stomach') or, in the case of severe reactions, actual vomiting." Nonetheless, this claim remains surprisingly untested at the experimental level (see also Rozin, Haidt, & McCauley, 2008). This suggests the need for studies to address both whether psychological disgust is rooted in the physiology of nausea and whether such feelings are causally related to moral judgments. I therefore conducted these studies and report the results in Chapter 2 of my dissertation.

1.6 Rational Assessments of Harm, Not Disgust, Drive Moral Judgments

Many of the critiques against intuitive morality raised so far challenge the claim that intuitions provide causal input into moral judgments by calling into question whether emotion – and especially the emotion of disgust – underlies or is necessary for generating moral judgments. In its place, researchers have generally focused on appeals to harm-based reasoning. Appeals to harm have long been viewed as supporting conscious linguistic reasoning causal models of moral judgment. For example, psychologists in the cognitive and rationalist tradition have shown that children seem to use perceptions of harmful consequences to classify something as a moral rule (e.g., don't steal) versus a conventional one (e.g., shake hands upon greeting; Nucci, Turiel, & Encarnacion-Gawrych, 1983; Turiel, 1983).

The idea that harm perceptions, and not emotionally charged intuitions, are the basis of moral judgments—even of seemingly harmless acts—stems from predictions from moral dyad theory. According to this theory, all moral judgments can be boiled down to a representation between a perceived intentional agent and a perceived suffering patient (Gray, Young, & Waytz, 2012; Gray, Waytz, & Young, 2012). Although moral dyad theory is not explicitly a theory of conscious deliberative linguistic moral reasoning *per se*, in that its proponents allow a causal role for harm-based intuition, the dyadic representation of agent acting on patient is nonetheless argued to be abstracted from the general structure of causality and, critically, language (Brown & Fish, 1983; Mikhail, 2007; Rochat, Striano, & Morgan, 2004; see Gray, Young, & Waytz, 2012). That is, proponents of moral dyad theory suggest the representations between intentional agent and suffering patient are rooted in the mechanics of language, although they do not expand on precisely what this means. In support of this notion that language-based representations of moral agent and patient are involved in reaching a moral judgment, researchers have found that

language-based manipulations influence intentionality judgments, with intentionality being an important factor in determining moral blameworthiness (e.g., Cushman, 2008). Specifically, manipulating the syntax of moral scenarios while keeping the content identical influences intentionality judgments (Strickland, Fisher, & Knobe, 2014). For example, participants viewed grammatical subjects as acting more intentionally than grammatical objects of a sentence, despite the sentences being logically the same (e.g., in a sentence taking the form "John married Susan", John is seen as acting more intentionally than Susan, despite both having to intend to marry for marriage to occur).

Similar to how critiques against moral intuition have emphasized the demonstration of a *lack* of importance for emotion (and instead highlighted appeals to harm), a critique against conscious linguistic reasoning might emphasize the demonstration of a lack of importance for conscious language-based processes (and instead highlight other processes that are sufficient to explain the causes of moral judgment). Whereas in Chapter 2 of my dissertation I test for the *presence* of a role for emotion in causing moral judgments, in Chapter 3 I test for the *absence* of a role for language-based reasoning in causing moral judgments; in other words, whether moral judgments can be made without such verbal reasoning. To do so, I test examine moral reasoning in a split-brain patient, in whom each hemisphere can be studied in relative isolation – an ideal case given that the left hemisphere is the language dominant hemisphere (Gazzaniga, 1995; Gazzaniga, 1970). I explain more about the logic of this choice of study population below.

1.7 Introduction to Split-Brain Patients

There exists a set of patients who underwent brain surgery in the 1960s, 70s, and 80s in an attempt to treat their severe epileptic seizures. In these individuals the corpus callosum – a large bundle of nerve fibers that allow the transfer of information between each cerebral

hemisphere – was severed, as it was thought that doing so would either significantly reduce the seizures or confine them to a single hemisphere. While the surgeries were generally quite successful at stopping the seizures (which tended not to occur in either hemisphere afterwards), the left and right cerebral hemispheres were left unable to communicate with each other, essentially creating two 'split-brains' in one body (Gazzaniga, 1967). Soon after these early surgeries, researchers began intensive study of these patients. While neuroscientists had been studying individuals with brain damage for some time already, these patients' lesions tended to be somewhat diffuse, making it difficult to assess whether any observed effects were due to specific brain areas lesioned or to other areas directly or indirectly affected by the lesion. Thus, one major benefit of studying split-brain patients to understand typical brain functioning is that each hemisphere is unlikely to have structural damage – that is, there tend not to be lesions in split-brain patients apart from the severed corpus callosum (Gazzaniga, 1995). The early studies of split-brain patients revealed a number of findings about normal brain structure functioning, some of which are important to review before explaining how and why split-brain patients can provide useful data on the question of the underlying psychological processes involved in generating moral judgments.

One relevant finding is that visual and tactile information do not transfer to the opposite hemisphere. For example, if a split-brain patient had an object placed in his right hand, he could describe it verbally (with his left hemisphere) but he could not describe an object placed in his left hand (with his right hemisphere; Gazzaniga, 1995). This makes sense given that the left hemisphere is dominant for language and speech whereas the control of the hands is contralateralized (so the left hemisphere largely controls the right hand and the right hemisphere largely controls the left hand; Gazzaniga, 1995). While research has found that split-brain

patients can have some impairments in short term memory (Zaidel & Sperry, 1974), more recent

evidence suggests that although free recall memory is somewhat impaired, recognition memory

remains intact (Phelps, Hirst, & Gazzaniga, 1991; Gazzaniga, 1995). This means that split-brain

patients generally have no difficulty recognizing something they have seen in the past if cued

with it (e.g., visually, and then having to determine whether they have seen it before), but may

present relative impairments if asked to free recall something without any reference cues.

Together, these studies suggest that, due to the overall lack of impairment resulting from the

surgery, the split-brain population can be studied without problematic motoric or cognitive

confounds.

In addition, because each hemisphere can be studied in isolation (by isolating responding

to movements controlled solely by a single hemisphere), and because there is evidence that

language-based verbal reasoning is at least somewhat lateralized to the left hemisphere

(Gazzaniga, 1970; Langdon & Warrington, 2000; Zaidel, 1991), split-brain patients offer a rare

and valuable study of moral judgments that can inform the moral intuition versus deliberative

linguistic moral reasoning debate. In other words, due to the hemispheric isolation that results

from severing the corpus callosum, research on these 'split-brain' patients can help to elucidate

the brain hemisphere regions necessary and sufficient for moral judgment (Funk & Gazzaniga,

2009).

So far, there has been only one published study on the moral judgments of split-brain

patients (Miller et al., 2010). These researchers examined moral judgments made by the language

dominant left hemisphere. They found that the left hemisphere, when disconnected from the

right, tended to downplay the intentions of what people meant to do relative to what ended up

happening despite their intentions. For example, compared to control participants, split-brain

patients were more likely to say that it was OK to attempt to poison someone so long as the attempt was botched and the target was not actually hurt in the end (Miller et al., 2010). By contrast, typically developing adults, whose hemispheres are intact, tend to evaluate moral permissibility based on the intentions behind the action, not the outcome itself, and thus would say that trying to poison someone is morally wrong, regardless of whether one's attempt is successful or not (e.g. Cushman, 2008). What this suggests is that the language dominant left hemisphere may be involved in generating moral judgments, but that processes in the right hemisphere are important, too. However, this research did not address (nor was it designed to address) whether language processes in the left hemisphere are necessary for generating moral judgments. As a result, it remains unclear whether the language-dominant left hemisphere is necessary for the generation of moral judgments.

1.8 Summary

In summary, during the cognitive revolution, moral judgment was seen as primarily caused by conscious language-based reasoning. At the start of the twenty-first century, a new science of morality arose, which suggested that automatic intuitions played a causal role in moral judgments. More recently, however, much of the evidence for intuitive morality has been called into question, supporting the possibility that deliberative reasoning is primarily causal of moral judgments.

The aim of my dissertation is to further test whether intuitive processes (versus conscious linguistic processes) are causally related to moral judgments. I aim to accomplish this goal through two sets of studies, which will be reported in Chapters 2 and 3 of my dissertation. In Chapter 2, I will focus on *emotion* as *source of input* for causing moral judgments. Specifically, I aim to tackle a debate about the putative role of feelings of disgust in causing moral judgments.

If disgust is found to be causally related to moral judgments, it would suggest that moral judgments are rooted at least partly in affective judgments that are independent of linguistic reasoning processes. I will also test whether disgust is causally related to moral judgments across the domains of purity and harm, or whether disgust's causal role is specific to the domain of purity. To accomplish this, I will attempt to inhibit spontaneous feelings of disgust and examine whether doing so has downstream consequences for moral judgments. If moral judgments result primarily from conscious linguistic reasoning about harm, then inhibiting feelings of disgust should not alter moral judgments. By contrast, if inhibiting disgust alters moral judgments, then this would suggest that disgust is a causal antecedent involved in the generation of moral judgment.

More specifically, in Chapter 2 of my dissertation, I present six studies that empirically test whether physiological disgust is causally related to moral judgments. Study 1 tests whether the antiemetic ginger powder (*Zingiber officinale*), known to reduce nausea in response to a variety of elicitors (e.g., Ernst & Pittler, 2000), reduces feelings of disgust toward physically disgusting images (e.g., feces). Study 5 tests the specificity of ginger's effect; that is, whether it reduces disgust by virtue of reducing negative emotions in general, or disgust in particular. The goal of Study 1 is to test, for the first time, whether psychological disgust is rooted in physiological nausea. Studies 2, 3, 4, and 6 also make use of the antiemetic ginger to test whether feelings of disgust are causally related to moral judgments in the domains of purity and harm.

In Chapter 3, I focus on testing for a *lack of importance* of *conscious linguistic reasoning* in the moral judgment process. In particular, I test (by examining the right hemisphere disconnected from the left), in split-brain patient J.W., whether neural circuitry in the language-

dominant left hemisphere is necessary for generating moral judgments, or if the right hemisphere is necessary and sufficient for moral judgments. I further test whether the left hemisphere demonstrates impoverished moral judgment when the moral input is presented non-linguistically, to examine possible limitations of the moral judgment capacities of the language dominant left hemisphere. To accomplish this, I examine moral judgments made by the disconnected left and right cerebral hemispheres of the split-brain patient J.W. Specifically, I will ask: Is a split-brain patient's right-hemisphere, which has very limited language capacity but excels at other tasks such as processing others' mental states, necessary and sufficient for generating moral judgments? If moral judgments can be normally generated without access to the language dominant left hemisphere, it would suggest that conscious linguistic reasoning is not required for generating moral judgments. I will also ask: Is a split brain patient's disconnected left hemisphere, which is preferential for language, capable of generating moral judgments when moral violations are presented non-linguistically? If the linguistically rich left hemisphere fails to generate normal moral judgments when presented with nonverbal moral stimuli, it would suggest a limitation of conscious linguistic reasoning: such processes may be capable of moral judgment only when the information is presented in a manner that is biased preferentially towards it.

Chapter 2: The Physiological Basis of Psychological Disgust and Moral Judgments

In the present research, we used a novel approach to test whether psychological feelings of disgust emerge from physiological nausea and whether these same feelings are elicited by thoughts of moral infractions and, in turn, promote harsher judgments of those infractions. Specifically, we adopted a pharmacological interference method to block spontaneously occurring feelings of disgust using ginger (*Zingiber officinale*), an effective antiemetic that has been shown to reduce nausea and vomiting in response to a variety of elicitors, including motion sickness, post-operative illness, pregnancy, and chemotherapy (Chaiyakunapruk et al., 2006; Ernst & Pittler, 2000; Lien et al., 2003). Our approach is similar to that employed in other research whereby acetaminophen was used to block physical feelings of pain in order to test the link between the biological system supporting physical pain and social pain or uncertainty (DeWall et al., 2010; Randles, Heine, & Santos, 2013; Randles, Kam, Heine, Inzlicht, & Handy, 2016).

No prior studies have examined whether such nausea feelings are literally—rather than metaphorically—related to disgust. That is, studies have yet to examine whether psychological self-reported feelings of disgust resulting from non-moral purity-violating stimuli (such as noxious odors or images of feces) are rooted in physiological feelings of nausea. Although people use words like "repulsion" and "sick" to describe their disgust feelings (e.g., Royzman et al., 2008), studies have not tested whether the emotional experience of disgust actually includes a nausea physiological component. Therefore, in Study 1 we tested whether ginger would reduce

psychological feelings of disgust toward traditional purity-violating stimuli outside the moral domain (e.g., images of feces).

In subsequent studies, we used the same approach to interfere with spontaneous feelings of disgust hypothesized to occur during the moral judgment process. Specifically, we then measured downstream consequences of this pharmacological inhibition on moral judgments toward purity-based infractions, that is, acts that are perceived as taboo or degrading (Rozin et al., 1999), and harm-based infractions. If spontaneous feelings of nausea occur as a result of thinking about a moral infraction, and increase the severity of judgments of that infraction, then inhibiting these feelings should reduce the severity of these judgments. If it is found that inhibiting nausea alters moral judgment severity, this would suggest that moral judgment is at least somewhat causally rooted in intuitive processes and is not solely the result of conscious linguistic reasoning.

2.1 Study 1

In Study 1 we conducted the first experimental test of whether physiological nausea is causally related to feelings of disgust. By inhibiting nausea via an induction of ginger and measuring disgust responses, our goal was to try to determine whether nausea is causally related to feelings of disgust presumably evoked by (non-moral) purity-offending stimuli – with the more distal goal of testing whether feelings of disgust are causally related to moral judgments.

2.1.1 Study 1: Method

Participants and Procedure

258 undergraduates participated in exchange for course credit. Sixteen participants were excluded due to procedural errors, resulting in a final sample of 242 (69% women, $M_{age} = 20.34$, $SD = 2.74$).

Participants were brought to the lab to participate in what they were told was a study of the effects of ginger on memory. In a double-blind design (i.e., both the experimenter and the participant were blind to each participant's assigned condition), participants were assigned to take either 1.5 grams of ginger (3 capsules in total) or 3 equivalently sized sugar-filled capsules; this amount of ginger was chosen based on prior studies examining the efficacy of ginger as an antiemetic, which have typically used doses of 1-2 grams (e.g., Chaiyakunapruk et al., 2006; Ernst & Pittler, 2000; Lien et al., 2003). Not all traces of ginger could be removed from the outside of ginger capsules, resulting in a mild ginger taste, so all capsules in both conditions were lightly dusted with ginger powder, and participants were informed of this. Although this resulted in some tiny amount of ginger being ingested by participants in the control condition, this methodological limitation works against our predicted effects, and rules out the possibility that any results are attributable to the taste of ginger as opposed to its pharmacological properties.

After ingesting the capsules, participants responded to demographic questions and then, for the sake of the cover story and to allow time for the ginger to digest, passively viewed (on a computer screen) a slideshow of photographs for presumed later recall. Each photo appeared for 7 seconds, and the entire slideshow lasted about 13 minutes. Most photos were drawn from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999) and were of neutral valence, but several disgusting photos were also included so that participants would not be surprised by the subsequent presentation of (different) disgusting photos during the test phase.

Prior studies on the efficacy of ginger for nausea reduction and the absorption of ginger's active ingredients suggest a delay of 30 minutes to 1 hour before testing its efficacy (e.g., Jiang, Wang, & Mi, 2008; Lien et al., 2003; and GRAVOL ginger recommends ingesting at least 30

minutes before motion-sickness inducing events). Therefore, after the slideshow ended participants completed several filler questionnaires to allow for ample time to pass. At 40 minutes post ingestion, participants were shown several new photos and asked to rate their emotional responses to each. Specifically, for each photo participants were asked, "How disgusted does this image make you feel?" Ratings were made on a 7-point Likert-scale, ranging from 1 (*not at all disgusted*) to 4 (*somewhat disgusted*) to 7 (*very disgusted*). Participants then responded to the same question rephrased for happiness, sadness, and anger. For the sake of the cover story, participants were finally asked whether they had seen the photo earlier in the study, and to rate their certainty of that judgment. Participants completed this entire set of questions for each photo before moving onto the next photo. Finally, they were asked to indicate whether they believed they had ingested ginger, sugar, or did not know.

Materials

No prior studies have examined whether ginger interferes with feelings of disgust, so we had no basis for predicting whether it would be effective for: (a) all purity-offending stimuli, (b) moderately purity-offending stimuli only, or (c) highly purity-offending stimuli only. If disgust is rooted in nausea, ginger might be efficacious for all purity-offending stimuli. However, it is also possible that ginger would reduce feelings of disgust only in situations where individuals are highly repulsed and feeling very nauseous. Alternatively, because ginger's effect on nausea is typically not very strong (e.g., Ernst & Pittler, 2000), it might not reduce feelings of disgust toward highly offensive stimuli—which are likely to have an overpowering impact—but instead be effective only for moderately offensive stimuli, which are more likely to lead to variable responses that could be influenced by a ginger-induced inhibition of physiological disgust (a range of effect sizes have been observed across studies using ginger as an antiemetic, but one

fairly representative meta-analysis observed a 31% reduction in the risk of post-operative nausea relative to those on a placebo; Chaiyakunapruk et al., 2006). Given this uncertainty, prior to data collection we pre-tested a set of images for their perceived disgustingness in order to separately examine ginger's efficacy regarding highly and moderately offensive stimuli.

Purity-offending photos were drawn from the International Affective Picture System (IAPS) as well as from internet searches. Five undergraduate research assistants viewed 16 images and rated each on a 7-point Likert-scale (ICC = .66). They were also asked whether the emotion of disgust or some other emotion best captured their reaction to each image. Based on their ratings, three photos were selected that were determined to be highly disgusting (diarrhea in a toilet, vomit in a toilet, and a man vomiting in a toilet), and were significantly more disgusting than three other photos that were determined to be moderately disgusting (snot in a napkin, rotten meat, and a man sneezing out particles in the direction of the camera): $M_{high} = 5.93(.76)$; $M_{moderate} = 3.60 (.83)$, paired-sample $t(4) = 3.38$ $p = .028$, ICC for selected stimuli = .73. These photos were selected over others because they most cleanly got at disgust in particular rather than other emotional states. Given that we had no strong expectations for whether ginger would more effectively reduce disgust toward highly versus moderately severe stimuli, we planned, prior to data collection, to separately examine the impact of ginger on each set of images; analyses are therefore presented separately for the two sets (with ancillary analyses conducted across stimulus set and treating severity as a factor). Interspersed among the disgust photos were 4 neutral photos: a chair, popsicles, a flower, and tissues. All photos were shown to participants in a within-subjects counterbalanced order.

2.1.2 Study 1: Results

Supporting the results of our pre-testing, participants judged the highly disgusting photos to be significantly more disgusting than the moderately disgusting photos, $M_{high} = 6.59$, $SD = .74$; $M_{moderate} = 5.20$, $SD = 1.14$; paired-sample $t(241) = 22.06$, $p < .0001$. Examining results for the highly disgusting images only, ginger did not significantly reduce feelings of disgust toward these stimuli; $M_{ginger} = 6.54$ ($SD = .81$); $M_{sugar} = 6.64$ ($SD = .66$), independent sample $t(240) = 1.04$, $d = .13$, 95% CI [-.12, .39], $p = .30$. In contrast, ginger did significantly reduce feelings of disgust toward the moderately disgusting images, $M_{ginger} = 5.06$ ($SD = 1.16$), $M_{sugar} = 5.35$ ($SD = 1.11$), independent sample $t(240) = 2.03$, $d = .26$, 95% CI [.008, .51] $p = .04$. Analyzing the data from moderately and highly severe disgusting stimuli together in a repeated-measures ANOVA, the interaction between condition and disgust severity did not reach statistical significance, $F(1, 240) = 2.41$, $p = .12$; however, the main effect of ginger on disgusting stimuli collapsing across severity was marginally significant, $F(1, 240) = 3.47$, $p = .064$.

The observed main effect of ginger on moderately severe stimuli was unique to disgust; no other emotional that were measured varied significantly between conditions, for either highly or moderately disgusting photos. Specifically, in response to highly disgusting photos, means for anger were $M_{ginger} = 2.89$ ($SD = 1.76$); $M_{sugar} = 2.95$ ($SD = 1.86$), independent sample $t(240) = .24$, $p = .81$; means for sadness were $M_{ginger} = 2.13$ ($SD = 1.51$); $M_{sugar} = 2.39$ ($SD = 1.76$), independent sample $t(240) = 1.22$, $p = .23$; and means for happiness were $M_{ginger} = 1.06$ ($SD = .25$); $M_{sugar} = 1.04$ ($SD = .17$), independent sample $t(240) = .66$, $p = .51$. In response to moderately disgusting photos, means for anger were $M_{ginger} = 2.38$ ($SD = 1.40$); $M_{sugar} = 2.34$ ($SD = 1.34$), independent sample $t(240) = .23$, $p = .82$; means for sadness were $M_{ginger} = 2.01$ ($SD =$

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1.11); $M_{sugar} = 2.02$ ($SD = 1.25$), independent sample $t(240) = .08$, $p = .94$; and means for happiness were $M_{ginger} = 1.30$ ($SD = .49$); $M_{sugar} = 1.23$ ($SD = .43$), independent sample $t(240) = 1.23$, $p = .22$.

To further probe this issue, we ran an ANCOVA predicting feelings of disgust toward moderately disgusting photos controlling for feelings of anger, and found that the effect of ginger held, $M_{ginger} = 5.06$ ($SD = 1.16$); $M_{sugar} = 5.35$ ($SD = 1.11$), $F(1, 239) = 5.45$, $p = .02$. This result also held controlling simultaneously for all emotions measured (anger, happiness, sadness): $M_{ginger} = 5.08$ ($SD = 1.16$); $M_{sugar} = 5.34$ ($SD = 1.11$), $F(1,237) = 4.12$, $p = .04$, and controlling for negative affect (based on the mean of anger and sadness), $M_{ginger} = 5.06$ ($SD = 1.16$); $M_{sugar} = 5.35$ ($SD = 1.11$), $F(1, 239) = 4.12$, $p = .04$.

We next examined whether the 95% confidence interval around the beta weight for the effect of condition predicting disgust feelings toward moderately severe stimuli contained the point estimate of condition predicting negative affect, and vice versa. In both cases, no such overlap was observed: $b_{disgust} = -.30$, 95% CI [-.60, -.005], $b_{NA} = .014$, 95% CI [-.28, .31]). These results further suggest that the ginger manipulation uniquely affected feelings of disgust.

We also conducted an ancillary analysis with hierarchical linear modeling testing for an interaction between emotion type (disgust versus negative affect, which was computed by taking the mean of anger, sadness), stimuli severity, and condition. The resulting 3-way interaction did not reach statistical significance, $b = -.37$, $t(720) = -1.54$, $p = .12$, but in this same model ginger still reduced disgust feelings toward moderately severe stimuli, $b = -.30$, $t(658) = -1.94$, $p = .053$, and not negative affect, $b = .014$, $t(658) = .093$, $p = .93$. It is noteworthy that we did not ensure

adequate power to test for an interaction along these lines, and had no strong *a priori* prediction

regarding whether ginger's effects would be stronger for moderately or highly severe stimuli, so

the non-significant interaction term should be interpreted with caution.

Next, to test whether these results might have been driven by demand characteristics (i.e.,

participants who ingested ginger might somehow have guessed that they were in that condition,

and, if aware of its antiemetic properties, shifted their responses accordingly), we examined

whether participants assigned to the ginger condition were aware of having ingested ginger.

Fifty-two participants guessed correctly, and 25 incorrectly, that they had ingested ginger. By

contrast, 17 participants guessed correctly, and 8 incorrectly, that they had ingested sugar. The

remainder of participants reported not knowing which condition they were in. Based on these

results, we created three new sub-samples of participants: (1) excluding those who correctly

guessed that they had ingested ginger, (2) excluding those who correctly guessed that they had

ingested ginger *and* those who believed they had ingested ginger but were incorrect, and (3)

excluding all participants who correctly guessed which condition they were in. We then re-ran

the main analysis, on moderately severe stimuli, separately for each of these subsamples. For all

three subsamples, the effect of ginger on feelings of disgust toward moderately disgusting stimuli

held; for Subsample 1, $M_{ginger} = 4.91$ ($SD = 1.14$); $M_{sugar} = 5.35$ ($SD = 1.11$), independent sample

$t(188) = 2.66$, $d = .39$, $p = .008$; for Subsample 2, $M_{ginger} = 4.91$ ($SD = 1.14$); $M_{sugar} = 5.33$ ($SD = 1.09$), independent sample $t(163) = 2.41$, $d = .38$, $p = .017$; and for Subsample 3, $M_{ginger} = 4.91$ ($SD = 1.14$); $M_{sugar} = 5.32$ ($SD = 1.14$), independent sample $t(171) = 2.36$, $d = .38$, $p = .019$.

As a final probe of this issue, we asked just under half the sample (47%) to "list what you

think the effects of ginger are on the body and/or brain." Not all participants were asked this

question because we decided to add it after data collection was already underway. The first author reviewed these open-ended responses and found that only 2 participants (out of 113) mentioned anything remotely related to nausea (these two responses were: "soothing for upset stomach" and "possibly assist in controlling stomach functions"). Four additional participants mentioned that ginger was used to treat "colds". Still, including these 4 participants, only .5% of participants surveyed reported any awareness of a link between ginger and sickness. The large majority of participants therefore seemed unaware of any association between ginger and nausea or disgust. In addition, it is unlikely that participants' reported lack of awareness of the true effects of ginger represent a response bias resulting from our cover story about memory whereby participants were most likely to recall that ginger has effects on memory: 62% of participants did in fact list effects outside the domain of memory, including increased emotionality, better health, clearing of the sinuses, and improved immune system functioning (the remainder of participants, 38%, reported effects related to memory).

2.1.3 Study 1: Discussion

In summary, the results of Study 1 provide the first evidence that physiological nausea is causally related to psychological feelings of disgust. In addition to providing new insights about the nature of disgust, these findings suggest that the use of ginger to inhibit feelings of disgust may be a valid method for testing whether such feelings naturally occur in response to thoughts of a moral infraction and are causally related to moral judgments. More specifically, the finding that ginger influenced responses to moderately but not highly disgusting stimuli is consistent with a severity hypothesis: ginger may only be an effective means of interfering with the impact of moderately disgusting/severe stimuli.

2.2   Study 2

In Study 2, we tested whether ginger reduced moral judgment severity in response to purity violations and to harm violations. Harm violations were either moral trolley dilemmas, in which two moral concerns were pitted against each other, or other scenarios involving a single moral violation. Because trolley scenarios involve solving a moral dilemma between two or more conflicting principles, these measures were analyzed separately from other harm-based scenarios.

2.2.1   Study 2: Method

Participants and Procedure

113 undergraduate students participated in exchange for course credit. Seventeen participants were excluded due to procedural errors, resulting in a final sample of 96 (60% women, $M_{age} = 20.19$, $SD = 2.18$).

Participants followed a similar procedure as in Study 1: we used the same cover story about a memory test, and the same experimental manipulation (1.5 grams of ginger or sugar, both in gel-capsules coated with ginger powder). There were, however, two critical differences from the procedure of Study 1. First, instead of the key dependent variable involving the judgment of disgusting photos, participants made judgments about several possible moral violations, on a scale from 1 (*Perfectly OK*) to 9 (*Extremely Wrong*).[1] Second, the disgusting photos used during the early "photo memorization" component of Study 1 were replaced with photos of a neutral valence so as to not accidentally induce feelings of disgust at any point in the

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[1] Responses to two possible moral violations were made using a slightly different scale: participants were asked about their support for legislation allowing first cousins to marry, on a scale from 1 (*Strongly Support Legalization*) to 9 (*Strongly Oppose Legalization*). Second, participants were asked about a potential privacy rights violation, using a scale from 1 (*Strongly Approve of Film Release*) to 9 (*Strongly Disapprove of Film Release*).

experiment, separate from feelings that might spontaneously occur as a result of reading about moral violations.

Materials

Moral vignettes were taken directly from past research (i.e., Schnall et al., 2008; see Appendix for all vignettes used). Vignettes included two trolley dilemmas (the switch case and the footbridge case), as well as four moral violations in the harm domain and four highly severe moral violations in the domain of purity. Because they are conceptually distinct, we analyzed results separately for the trolley dilemmas, harm violations, and highly severe purity violations. As this was our first exploration of whether ginger influenced harm violations, we did not systematically examine the severity of harm violations prior to conducting Study 2.

2.2.2 Study 2: Results

We found no evidence that ginger reduced the severity of participants' judgments about harm violations, $M_{\text{ginger}} = 5.71$ ($SD = 1.30$); $M_{\text{sugar}} = 5.64$ ($SD = 1.22$), independent sample $t(94) = .28$, $d = .06$, 95% CI [-.35, .45], $p = .78$, or highly severe purity violations, $M_{\text{ginger}} = 7.10$ ($SD = 1.49$); $M_{\text{sugar}} = 6.89$ ($SD = 1.60$), independent sample $t(96) = .67$, $d = .14$, 95% CI [-.27, .54] $p = .51$. Turning to the trolley dilemmas, participants in the ginger condition made relatively less deontological (i.e., emotionally-driven; Greene et al., 2001) moral judgments, $M_{\text{ginger}} = 4.78$ ($SD = 1.99$); $M_{\text{sugar}} = 6.01$ ($SD = 1.89$), independent sample $t(94) = 3.10$, $d = .63$, 95% CI [.22, 1.04], $p = .003$. Breaking this down further by trolley dilemma type, this effect was larger for the switch case ($M_{\text{ginger}} = 3.56$ ($SD = 2.18$); $M_{\text{sugar}} = 5.35$ ($SD = 2.14$), independent sample $t(94) = 4.06$, $d = .83$, 95% CI [.41, 1.24], $p < .0001$) than the footbridge case ($M_{\text{ginger}} = 6.00$ ($SD = 2.57$); $M_{\text{sugar}} = 6.67$ ($SD = 2.17$), independent sample $t(94) = 1.38$, $d = .28$, 95% CI [-.12, .68], $p = .17$).

2.2.3   Study 2: Discussion

This finding regarding the trolley dilemmas is in line with the severity hypothesis outlined in Study 1, given that prior research has shown that the footbridge case is more strongly associated with an emotional response than the switch case (Greene et al., 2001). That is, it may be that the highly activated emotions evoked from the footbridge case overpowered the ginger manipulation, resulting in a weaker and non-significant effect of condition, whereas ginger was strong enough to have an effect on the less emotionally charged switch case. However, the sample size in this study was very small. Therefore, one goal of Study 3 was to attempt to replicate this effect with a larger sample size. We pre-registered this direct replication attempt on the Open Science Framework (see: https://osf.io/z8nat/). In Study 2, no evidence was found that ginger reduces moral judgment in the purity domain. This lack of evidence for a role of disgust in the purity domain could have been for two reasons. First, with our small sample we did not have sufficient power to detect an effect. Second, the stimuli used my have been of too high a severity, thereby making it difficult for ginger to exert an effect, as suggested by the trolley problem results. Thus, in Study 3, we also followed up on this severity hypothesis and focused on testing whether ginger reduces moral judgment severity in the purity domain by specifically comparing its effects on highly severe and moderately severe moral violations. The severity hypothesis also bears on another related issue that we explored in Study 3. Some people may have differing severity of bodily emotional responses to the stimuli that they are exposed to. For example, some people may be very sensitive to their disgust feelings, and may readily experience nausea, whereas other people may be relatively immune from subjectively feeling nausea in response to disgusting stimuli. This individual difference of bodily sensation awareness has been measured in prior research using the Private Body Consciousness Scale (Baradell & Klein, 1993;

Miller et al., 1981). Prior research has found that this individual difference variable at times interacts with disgust manipulations to impact moral judgment ratings (e.g., Schnall et al., 2008). Thus, given that we find ginger to be effective only stimuli of a certain severity, in Study 3 we also explored whether ginger interacts with the severity with which people subjectively feel their bodily sensations.

2.3 Study 3

More specifically, because we found more evidence consistent with Study 1 that ginger is effective only on moderate stimuli (in Study 2, the trolley cases), in Study 3 we expected the strongest effects of ginger on moderately severe stimuli. The severity of In Study 3 we also conducted an exploratory test of whether ginger moderates the effect of bodily sensation awareness on moral judgments. Prior research has found that people with a heightened awareness of their bodily sensations tend to make more severe moral judgments (Johnson et al., 2016). If people with a heightened awareness of their bodily sensations tend to make more severe moral judgments because they are particularly attuned to any nauseous response they might experience to moral stimuli, then by inhibiting nausea, ginger might sever the otherwise positive association between bodily awareness and moral judgment severity (i.e., if there is little nausea to be sensitive to, bodily sensation awareness should have little impact on psychological responses to nausea). In Study 3, we focused on testing whether ginger reduces moral judgment severity in the purity domain by specifically comparing its effects on highly severe and moderately severe moral violations. We also sought to replicate the trolley effect using a larger sample.

2.3.1 Study 3: Method

Participants and Procedure

307 undergraduate students participated in exchange for course credit. One participant was excluded due to a procedural error, resulting in a final sample of 306 (80% women, $M_{age} = 20.39$, $SD = 3.31$). The final sample size was determined in part from a power analysis based on 75% power to detect an effect size similar to that observed in Study 1, and in part by aiming to collect as much data as possible until the end of the school semester, even if that meant including a sample slightly larger than the calculated estimate.

Participants followed a near identical procedure as in Study 2: we again used the same cover story about a memory test, and the same experimental manipulation (1.5 grams of ginger or sugar, both in gel-capsules coated with ginger powder). There was, however, one critical difference from the procedure of Study 2. Because prior studies examining the effect of incidentally induced disgust on moral judgments have found that this effect is particularly pronounced among individuals who are highly aware of their internal bodily sensations (e.g., Schnall et al., 2008), we measured this dispositional tendency, using the same scale that has been used to measure it in the relevant past research—the Private Body Consciousness Scale (Baradell & Klein, 1993; Miller et al., 1981; see Appendix A). If incidental disgust is particularly effective in increasing moral judgment severity among people who are highly aware of their bodily sensations because these people are more attuned to their feelings and use them to inform their judgments accordingly, then the same may be the case for spontaneously occurring disgust. In particular, we expected that disrupting disgust with ginger might sever any link between these feelings and moral judgments, resulting in an interaction between the ginger manipulation and bodily sensation awareness.

In addition, in Study 3 we measured post-task disgust and other emotions, so that we could assess whether disgust feelings differed by condition. We specifically did not obtain a

direct measure of disgust in response to the various moral violations so that we could avoid inadvertently priming certain moral judgments in participants as they thought about their disgust feelings. Instead, at the very end of the experiment (after making moral judgment ratings to all the vignettes and after reporting their bodily sensation awareness), participants were asked to "rate the extent to which you feel each of the following emotions, right now" (in the following order: angry, anxious, afraid, disgusted, embarrassed, happy, proud, sad) on a scale from 1 (*Not at all*) to 4 (*Somewhat*) to 7 (*Very*) (due to a clerical error, anger was assessed on a 9-point scale).

Materials

As in Study 1, prior to data collection we pre-tested a set of purity infractions for their severity. These vignettes were taken either directly from past research (i.e., Schnall et al., 2008), amended slightly from past research (i.e., Rozin et al., 1999), or constructed anew in their entirety for the present research. To pre-test the severity of these 13 vignettes, twelve undergraduate research assistants and graduate students read and rated each on a 9-point Likert-scale ranging from 1 (*Perfectly OK*) to 9 (*Extremely Wrong*); ICC = .81. We then selected 4 highly severe and 4 moderately severe moral violations for inclusion (see SOM9, ICC = .74): $M_{High} = 5.31(SD = 1.74)$; $M_{Moderate} = 3.58$ ($SD = 1.24$), paired-sample $t(11) = 3.83$ $p = .003$. We again separately analyzed responses to highly and moderately severe moral violations, and pre-registered our prediction that ginger would be most effective for reducing responses to moderately severe infractions specifically (see https://osf.io/z8nat/).

2.3.2   Study 3: Results

Confirming pre-testing, participants judged the highly severe moral violations to be significantly more wrong than the moderately severe violations, $M_{high} = 7.18$, $SD = 1.48$; $M_{moderate} = 5.91$, $SD = 1.72$; paired-sample $t(305) = 14.13$, $p < .0001$. In addition, consistent with prior research (Johnson et al., 2016), a main effect of bodily sensation awareness emerged on judgments of moderately severe violations, such that participants higher in bodily sensation awareness perceived these transgressions to be more wrong, $b = .26$, $t(302) = 2.02$, $p = .044$, as would be expected if participants were relying, to some extent, on their bodily sensations to make these judgments. For the highly severe violations, there was also a main effect of bodily sensation awareness, with participants higher in this trait also judging these violations as more wrong, $b = .30$, $t(302) = 2.76$, $p = .006$. Importantly, although bodily sensation awareness was measured toward the end of the experiment, mean levels of this trait did not vary as a function of condition, $M_{ginger} = 4.37$ ($SD = .73$); $M_{sugar} = 4.35$ ($SD = .83$), independent sample $t(304) = .26$, $p = .80$.

Turning to our experimental manipulation, consistent with our pre-registered hypotheses, ginger reduced the severity of participants' judgments about moderate purity violations, $M_{ginger} = 5.71$ ($SD = 1.82$); $M_{sugar} = 6.11$ ($SD = 1.60$), independent sample $t(304) = 2.08$, $d = .23$, 95% CI [.013, .46], $p = .039$, but not about highly severe violations, $M_{ginger} = 7.21$ ($SD = 1.46$); $M_{sugar} = 7.16$ ($SD = 1.50$), independent sample $t(304) = .33$, $d = .03$, 95% CI [-.19, .26] $p = .74$. In contrast, no significant effect of ginger emerged for either trolley case. Specifically, for the switch case, $M_{ginger} = 5.46$ ($SD = 2.16$); $M_{sugar} = 5.32$ ($SD = 1.98$), independent sample $t(304) =$

.60, $p = .55$; and for the footbridge case, $M_{ginger} = 6.57$ ($SD = 2.11$); $M_{sugar} = 6.63$ ($SD = 1.95$), independent sample $t(304) = .28$, $p = .78$.

Turning back to the purity domain, although our preregistered predictions focused on the specific effect of ginger on moderately severe purity stimuli, for the sake of completeness we also analyzed the data from both conditions together using a repeated measures ANOVA, and found a significant interaction between condition and moral violation severity, $F(1, 304) = 6.70$, $p = .01$ [the main effect of ginger collapsing across moral violation severity was not significant, $F(1, 304) = 1.20$, $p = .27$].

We next tested whether ginger moderated the relationship between bodily sensation awareness and moral judgment severity. For both moderately and highly severe violations, no interaction emerged, $b = -.006$, $t(238) = -.05$, $p = .96$ for moderate violations; $b = .018$, $t(302) = .17$, $p = .87$, for highly severe violations. Again for completeness we next used multilevel modeling to test for a three-way interaction between condition, stimuli severity, and bodily sensations, predicting moral judgments. No significant interaction emerged, $b = -.05$, $t(302) = -.21$, $p = .83$.

To test whether the main effect of ginger on judgments of moderate violations might have been driven by demand characteristics, we next examined whether participants in the ginger condition were aware of being in that condition. Sixty-one participants guessed correctly, and 20 incorrectly, that they had ingested ginger. By contrast, 36 participants guessed correctly, and 16 incorrectly, that they had ingested sugar. The remainder of participants reported not knowing which condition they were in. As in Study 1, we next re-ran the main analysis, testing for an

effect of ginger on moderately severe stimuli, for three separate subsamples of participants: (1) excluding those who correctly guessed that they had ingested ginger, (2) excluding those who correctly guessed that they had ingested ginger *and* those who believed they had ingested ginger but were incorrect, and (3) excluding all participants who correctly guessed which condition they were in. Once again, the effect of ginger on judgments of moderate stimuli held in all three subsamples; for Subsample 1, $M_{ginger} = 5.49$ ($SD = 1.95$); $M_{sugar} = 6.11$ ($SD = 1.60$), independent sample $t(243) = 2.69$, $d = .36$, $p = .008$; for Subsample 2, $M_{ginger} = 5.49$ ($SD = 1.95$); $M_{sugar} = 6.06$ ($SD = 1.54$), independent sample $t(223) = 2.42$, $d = .33$, $p = .016$; and for Subsample 3, $M_{ginger} = 5.49$ ($SD = 1.95$); $M_{sugar} = 6.11$ ($SD = 1.59$), independent sample $t(207) = 2.51$, $d = .35$, $p = .013$. These results again suggest that the observed effects are unlikely to be due to demand characteristics, and their consistency across subsamples attests to their robustness.

Turning to the post task emotion measures, disgust ratings did not differ significantly by condition, $M_{ginger} = 2.39$ ($SD = 1.73$); $M_{sugar} = 2.68$ ($SD = 1.81$), independent sample $t(304) = 1.39$, $p = .17$. No other emotions measured varied significantly by condition either (ps $\geq .098$). However, when excluding participants in the ginger condition who reported being aware of their condition (40% of participants in that condition), post task disgust feelings (but not any other emotion measured) varied significantly by condition, $M_{ginger} = 2.13$ ($SD = 1.50$); $M_{sugar} = 2.68$ ($SD = 1.81$), independent sample $t(243) = 2.42$, $p = .01$. To better examine whether this effect was specific to disgust, we created a standardized negative affect composite based on the other negative emotions measured (anger, anxiety, fear, embarrassment, and sadness). In contrast to disgust, feelings of negative affect did not differ significantly by condition, $M_{ginger} = -.10$ ($SD =$

.65); $M_{\text{sugar}} = .04$ ($SD = .77$), independent sample $t(243) = 1.53$, $p = .13$, when excluding

participants who correctly guessed they were in the ginger condition.

We next examined whether post task disgust feelings mediated the relationship between

condition and moral judgment severity toward the moderate purity violations, again excluding

participants who correctly guessed that they were in the ginger condition. First, we examined the

direct effect of condition on moral judgment severity toward moderate purity violations: $B = -.17$, $p = .008$. Next, we tested whether condition predicted post task disgust feelings (ginger

coded as 1, sugar coded as 0). We found that condition negatively predicted post task disgust: $B = -.15$, $p = .016$. Next, we tested whether post task disgust positively predicted judgment severity

toward the moderate purity violations: $B = .28$, $p < .0001$. Finally, using the partial posterior

method (Biesanz, Falk, & Savalei, 2010), we tested for mediation by examining whether the

indirect effect, ab, was significant, and found evidence consistent with mediation, $p = .013$.

When these same analyses were conducted additionally excluding participants who

correctly guessed that they had ingested sugar (23% of participants in that condition), a similar

pattern emerged: $M_{\text{ginger}} = 2.13$ ($SD = 1.50$); $M_{\text{sugar}} = 2.72$ ($SD = 1.85$), independent sample

$t(207) = 2.47$, $p = .01$; $ab = -.20$, $p = .01$.

Finally, when excluding all participants who believed that they had ingested ginger (some

incorrectly), results again held: $M_{\text{ginger}} = 2.13$ ($SD = 1.50$); $M_{\text{sugar}} = 2.66$ ($SD = 1.78$), independent

sample $t(223) = 2.34$, $p = .02$; $ab = -.13$, $p = .011$. In all subsamples dealing with possible

demand issues, then, post-task disgust mediated the effect of ginger on moral judgments,

providing support for the claim that ginger influenced these judgments by virtue of its effect on

disgust.

2.3.3   Study 3: Discussion

These results provide the first empirical evidence that physiological feelings of disgust—the same nausea-based feelings elicited by non-moral purity-offending stimuli—are causally related to moral judgments in the purity domain. By contrast, we failed to replicate an effect on ginger on trolley moral dilemmas with the larger sample size of Study 3, suggesting the effect of ginger on trolley dilemmas in Study 2 may have been spurious. Given the specificity of the effect found in Study 3, these results also provide further support for the suggestion that ginger is an effective interference tool for judgments of moderately severe disgust-inducing stimuli only. The narrowness of the effect may be due to individuals holding prior strong cognitive beliefs about the moral wrongness (or disgustingness) of more severe violations, making these beliefs more immune to the impact of momentary emotional responses (Robinson & Clore, 2002). It may also be the case that ginger is too weak to inhibit the strong feelings of disgust likely elicited by highly severe violations (e.g., a man rubbing a kitten on his genitals to pleasure himself) and highly offensive images.

The mediation analyses tentatively suggest that the effect of ginger on moral judgments was due to its effect on dampening disgust. However, the mediation analyses and post-task disgust measure should be interpreted with caution. Disgust was measured only at the very end of the experiment, and not specifically toward the vignettes, so it is not clear what participants were disgusted by at that moment, and in fact no emotion assessed at that point was particularly strongly activated: On a 7-point Likert-scale, the highest mean emotion rating was happiness, $M = 3.86$, with the negative emotions measured (anger, anxiety, disgust, embarrassment, fear, sadness) ranging from $M = 1.73$ to $M = 2.87$. Nonetheless, the observed findings are consistent with the suggestion that disgust feelings elicited by the purity infractions were less intense for

participants in the ginger condition—and remained so a few minutes after reading about these infractions, at the end of the study – and this reduction in disgust is what accounted for these participants' less severe moral judgments. We suggest that future studies using a similar method to ours seek to test whether feelings of disgust experienced *in response to moral vignettes* mediate the effect of ginger on judgments of those vignettes, ideally using an unobtrusive means of assessing disgust (to avoid influencing moral judgments by asking participants to simultaneously report their feelings of disgust).

2.4   Study 4

In Study 4 we sought to replicate the main finding in Study 3 using a substantially larger sample. We again also tested for an interaction with the individual-difference measure of awareness of one's bodily sensations.

2.4.1   Study 4: Method

Participants and Procedure

515 undergraduate students participated in exchange for course credit. Eighteen participants were excluded due to procedural errors, for a final sample of 497 (75% women, M_{age} = 20.01, SD = 2.30). Participants followed a procedure identical to that used in Study 3. Sample size was determined in part from a power analysis based on 75% power to detect a small interaction effect, and in part by aiming to collect as much data as possible until the end of the school semester even if that meant including a sample slightly larger than the calculated estimate.

2.4.2 Study 4: Results

Once again, participants judged the highly severe moral violations to be significantly more wrong than the moderately severe violations, $M_{high} = 7.11$, $SD = 1.47$; $M_{moderate} = 5.84$, $SD = 1.72$; paired-sample $t(496) = 17.87$, $p < .0001$. Following our pre-registered predictions for Study 3, we again separately examined results for moderately and highly severe violations. For moderate violations, as was the case in Study 3, a main effect of bodily sensation awareness emerged on judgments of moral wrongness, $b = .28$, $t(495) = 2.80$, $p = .005$. In contrast with Study 3, however, no main effect emerged for ginger on these judgments, $b = .03$, $t(495) = .39$, $p = .70$; $M_{ginger} = 5.87$ ($SD = 1.73$); $M_{sugar} = 5.82$ ($SD = 1.75$), independent sample $t(495) = .32$, $d = .03$, 95% CI [-.14, .20], $p = .75$.

However, we did find an interaction between experimental condition and bodily sensation awareness predicting judgments of moderate violations, $b = -.18$, $t(495) = -1.86$, $p = .063$. Breaking this down by condition revealed that ginger disrupted the link between people's bodily sensation awareness and their moral judgments: whereas awareness of bodily sensations positively predicted how morally wrong participants in the sugar condition judged the moderate infractions to be, $b = .46$, $p = .0006$, for participants who ingested ginger the relation between bodily sensation awareness and moral judgment severity was dissipated, $b = .09$, $p = .53$. This difference suggests that by inhibiting nausea, the physiological component underlying feelings of

disgust, ginger prevented individuals with a normally heightened awareness of those feelings from using them to inform their moral judgments (see Figure 1).[2]

Figure 1 – Interaction between Experimental Condition and Bodily Sensation Awareness Predicting Moral Judgments in Study 4.
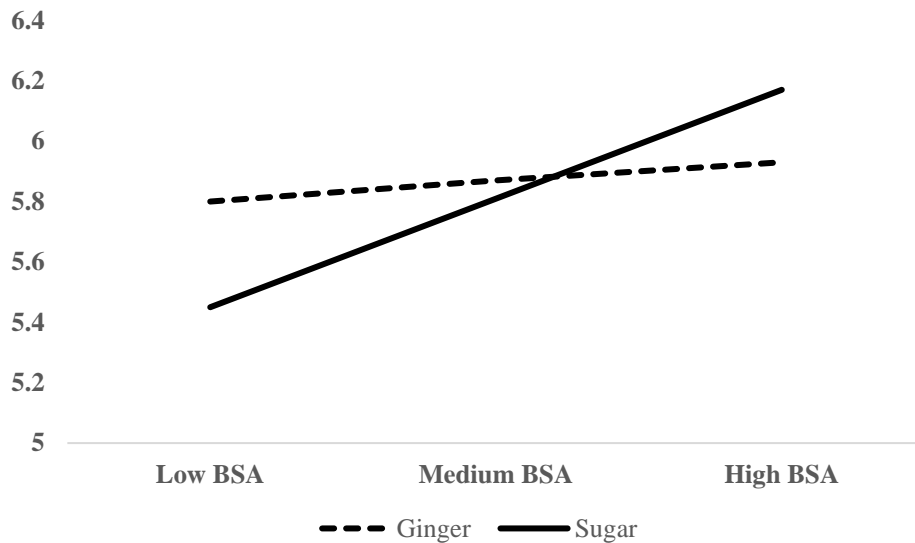
Note: The Y-axis represents judgment severity of moderate purity-based moral infractions. The X-axis represents effects of bodily sensation awareness at -1 SD, Mean, and +1 SD. In the sugar condition, bodily sensation awareness positively predicted moral judgment severity ($b=.46$, $p=.0006$). In contrast, in the ginger condition this relationship was substantially reduced ($b=.09$, $p=.53$), suggesting that by inhibiting the physiological component underlying disgust (i.e.,

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[2] We also examined the simple slopes of bodily sensation awareness (BSA) moderating the effect of condition (ginger = 1; sugar = 0): $b_{lowBSA} = .35$, $p = .11$; $b_{mediumBSA} = .06$, $p = .70$; $b_{highBSA} = -.23$, $p = .30$. Although for those high in BSA the simple slope of experimental condition was in a theoretically sensible direction, it was not statistically significant.

nausea), ginger disrupted the link between individuals' awareness of their disgust feelings and the severity of their moral judgments.

Turning to the highly severe violations, replicating Study 3, a main effect of bodily sensation awareness emerged, such that those higher in awareness of their bodily sensations judged highly severe violations as more wrong, $b = .28$, $t(495) = 3.35$, $p = .001$. Also consistent with Study 3, neither an interaction between bodily sensation awareness and experimental condition, $b = .009$, $t(495) = .10$, $p = .92$, nor a main effect of condition, $b = .09$, $t(495) = 1.36$, $p = .17$, emerged; $M_{ginger} = 7.19$ ($SD = 1.39$); $M_{sugar} = 7.03$ ($SD = 1.55$), independent sample $t(495) = 1.27$, $d = .11$, 95% CI [-.06, .29], $p = .20$. Importantly, there was no main effect of condition on participants' ratings of their trait bodily sensation awareness, $M_{ginger} = 4.33$ ($SD = .74$); $M_{sugar} = 4.35$ ($SD = .83$), independent sample $t(496) = .40$, $p = .69$.

Again for completeness we used multilevel modeling to conduct an additional analysis testing for a 3-way interaction between condition, stimuli severity, and bodily sensation awareness, predicting moral judgments. A significant 3-way interaction emerged, $b = .39$, $t(493) = 2.12$, $p = .034$, consistent with our finding that the effects of ginger (in this case on the relation between bodily sensation awareness and moral judgments) differ for moderately and highly severe stimuli.

Although demand characteristics are a less likely explanation for the observed interaction effect than for the main effect observed in Studies 1 and 2, we nonetheless again examined whether participants' awareness of having ingested ginger might have influenced results. In total, 114 participants correctly, and 37 incorrectly, guessed that they had ingested ginger. By contrast,

55 participants correctly, and 27 incorrectly, guessed that they had ingested sugar. The remainder of participants reported not knowing which condition they were in. We re-ran the main interaction analysis on moderately severe stimuli separately for each of the three subsamples created in Studies 1 and 2: (1) excluding those who correctly guessed that they had ingested ginger, (2) excluding those who correctly guessed that they had ingested ginger and those who believed they had ingested ginger but were incorrect, and (3) excluding all participants who correctly guessed which condition they were in. Once again, the observed interaction effect held for all three subsamples; for Subsample 1, $b = -.24$, $p = .04$; for Subsample 2, $b = -.25$, $p = .036$; and for Subsample 3, $b = -.25$, $p = .046$.

2.4.3   Study 4: Discussion

Overall, these results provide tentative additional support for the conclusion from Study 3 that physiological feelings of nausea are causally related to moral judgments of moderately (but not highly) severe purity violations, by demonstrating that biologically interfering with these feelings reduces perceptions of moral wrongness. In Study 3, this finding emerged as a main effect, whereas in Study 4 it emerged as an interaction between the ginger interference manipulation and participants' varying levels of bodily sensation awareness. This interaction suggests that ginger disrupted the link between people's awareness of their bodily sensations and their moral evaluations, such that they became less able to use physiologically based affective-disgust information to inform their moral judgments when that information was inhibited.

However, this conclusion presumes that ginger acted solely on the emotion of disgust – and not other negative emotions that might be causally related to moral judgments. That is, it is

possible that ginger reduces not feelings of disgust in particular but instead reduces all negative emotions, or, perhaps, arousal more broadly. Although in Study 1 we measured other emotions and found the effect of ginger to be specific to disgust, participants only saw disgusting or neutral stimuli. Due to the nature of the stimuli used in Study 1, then, emotions other than disgust might not have been activated strongly enough for ginger to have had any effect on them. An alternative explanation, then, is that ginger's effect is not restricted to disgust, but rather has a broader reductive impact on negative affect or arousal, and these states are causally related to moral judgments.

2.5   Study 5

In Study 5, we directly tested whether ginger acts specifically on disgust or more broadly on arousal or negative affect, by showing participants fear-inducing stimuli and testing whether their feelings of fear in response were affected by ginger. If ginger reduces feelings of fear toward fear-inducing stimuli, it would suggest that ginger as a manipulation is not disgust-specific and prevent us from concluding that physiologically rooted disgust is causally related to moral judgments in the purity domain. However, if ginger does not reduce feelings of fear toward fear-provoking stimuli, it would bolster the view of the data presented thus far, that moral judgments of purity violations are in part a causal consequence of physiologically rooted disgust.

2.5.1   Study 5: Method

Participants and Procedure

278 undergraduate students participated in exchange for course credit. Seven participants were excluded due to procedural errors, for a final sample of 271 (75% women, $M_{age} = 20.06$, $SD = 3.37$). Sample size was determined on the basis of 80% power to detect a small-to-moderate

effect size, in a range similar to that found in Study 1. Participants followed a procedure nearly identical to that used in Study 1 except that rather than rating disgusting and neutral photos toward the end of the experiment, participants instead made ratings on fear-inducing stimuli and neutral stimuli. In addition, the participants in this sample also participated in Study 6 (see below); as such, prior to seeing and making ratings on the fear-inducing stimuli, participants responded to moral vignettes in the harm domain (see Study 6 for more details).

Materials

Prior to data collection we pre-tested a set of (fear-inducing) stimuli for their severity. Pre-testing occurred in two rounds. In the first round, fear-inducing photos (drawn from the internet) were found to elicit very low levels of fear among a small sample of undergraduate research assistants [$n = 9$; M fear rating across photos = 2.69, SD = 1.38, on a scale from 1 (*Not at all afraid*) to 4 (*Somewhat afraid*) 7 (*Very afraid*)]. Several researchers have suggested that stimulus movement is an important factor for the elicitation of fear (e.g., Courtney, Dawson, Schell, Iyer, & Parsons, 2010), so we next pre-tested a set of 26 fear-inducing GIFs (images with small amounts of movement) as potential stimuli; these were also found from internet searches. Five undergraduate research assistants viewed these 26 GIFs and rated each on a 7-point Likert-scale ranging from 1 (*Not at all afraid*) to 4 (*Somewhat afraid*) to 7 (*Very afraid*). They were also asked whether the emotion of fear or some other emotion best captured their reaction to each image. Based on their ratings, three GIFs were selected as a highly frightening stimulus set (a shadowy figure in a hallway, a spooky face in the dark, a ghost who suddenly appears), and were found to be significantly more frightening than three other GIFs that were determined to be moderately frightening (a mannequin head with beaming eyes, a girl sleeping with a doll whose

eyes are blinking, an "out of focus" boy standing over someone sleeping): $M_{\text{high}} = 5.20$ (.99); $M_{\text{moderate}} = 3.40$ (.43), paired-sample $t(4) = 3.14$, $p = .035$.

As in previous studies, prior to data collection, we planned to separately examine the impact of ginger on each set of images; analyses are therefore presented separately for these two sets images. Interspersed among the fear stimuli were 5 neutral photos: a lightbulb, an umbrella, a ferryboat, a chair, and a spoon. All stimuli (GIFs and photos) were shown to participants in a within-subjects counterbalanced order. We hypothesized that the effects of ginger would be specific to disgust, and therefore that ginger would not meaningfully or significantly affect feelings of fear in response to either the highly or moderately frightening stimuli.

2.5.2   Study 5: Results

As in the pre-testing, participants judged the highly frightening stimuli to be significantly scarier than the moderately frightening stimuli, $M_{\text{high}} = 4.98$, $SD = 1.53$; $M_{\text{moderate}} = 4.35$, $SD = 1.66$; paired-sample $t(270) = 9.34$, $p < .0001$. As expected, we found no evidence for a significant effect of ginger on fear, for either highly severe [$M_{\text{ginger}} = 5.06$ ($SD = 1.47$); $M_{\text{sugar}} = 4.90$ ($SD = 1.58$), independent sample $t(269) = .87$, $d = .10$, 95% CI [-.13, .34], $p = .39$] or moderately severe [$M_{\text{ginger}} = 4.39$ ($SD = 1.66$), $M_{\text{sugar}} = 4.31$ ($SD = 1.66$), independent sample $t(269) = .39$, $d = .05$, 95% CI [-.19, .29] $p = .70$] stimuli.

No other emotions that were measured (anger, disgust, happiness) differed significantly between conditions for either highly or moderately frightening stimuli. Specifically, for highly frightening GIFs, feelings of anger were unaffected by the manipulation, $M_{\text{ginger}} = 2.24$ ($SD = 1.50$); $M_{\text{sugar}} = 2.15$ ($SD = 1.43$), independent sample $t(269) = .52$, $p = .60$; for moderately frightening GIFs, feelings of anger were unaffected by the manipulation, $M_{\text{ginger}} = 2.22$ ($SD = 1.49$); $M_{\text{sugar}} = 2.17$ ($SD = 1.43$), independent sample $t(269) = .26$, $p = .79$. Similarly, for highly

frightening GIFs, feelings of disgust were unaffected by the manipulation, $M_{\text{ginger}} = 3.06$ ($SD = 1.70$); $M_{\text{sugar}} = 2.97$ ($SD = 1.71$), independent sample $t(269) = .43$, $p = .67$; for moderately frightening GIFs, feelings of disgust were unaffected by the manipulation, $M_{\text{ginger}} = 3.12$ ($SD = 1.62$); $M_{\text{sugar}} = 3.06$ ($SD = 1.65$), independent sample $t(269) = .30$, $p = .76$. For highly frightening GIFs, feelings of happiness were unaffected by the manipulation, $M_{\text{ginger}} = 1.12$ ($SD = .35$); $M_{\text{sugar}} = 1.17$ ($SD = .50$), independent sample $t(269) = .85$, $p = .40$; for moderately frightening GIFs, feelings of happiness were unaffected by the manipulation, $M_{\text{ginger}} = 1.17$ ($SD = .42$); $M_{\text{sugar}} = 1.16$ ($SD = .46$), independent sample $t(269) = .21$, $p = .83$.

2.5.3   Study 5: Discussion

The results of Study 5 suggest that the effect of ginger on disgust and moral judgment documented in prior studies was specific to disgust and was not attributable to ginger acting more broadly on arousal or negative affect. That is, because like disgust, fear is a high arousal negative emotion, these findings suggest that ginger does not dampen just any high arousal negative emotion. However, future research should also examine the effect of ginger on anger, another negative emotion more commonly considered a moral emotion than fear, to conclude with more certainty that ginger does not act on negative affect more broadly. Given this evidence suggesting the effect of ginger is specific to the emotion of disgust, we next turned to more thoroughly test whether the causal effect of disgust on moral judgments is specific to the purity domain or whether disgust also has a causal role for moral judgments regarding potential harm violations.

2.6   Study 6

The goal of Study 6 was to further examine whether disgust might be causally related to moral judgments in a domain other than purity. Although we began to test in prior studies

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whether disgust plays a causal role in moral judgments of harm violations, we did not give the severity hypothesis in the domain of harm a fair test (as a reminder, this is the hypothesis that ginger is an effective interference technique only for stimuli of a moderate nature). Although there were hints of a possibly severity effect for the trolley dilemmas, this effect did not replicate in Study 3. And, though we examined the impact of ginger on other harm violations, we did not pre-test these violations to determine and systematically manipulate whether they were of a high versus moderate severity (as did we did for the purity violations). It is possible therefore that ginger would effectively reduce the severity of judgments toward harm-based moral violations of a moderate severity. In Study 6, we sought to more directly test whether ginger reduces moral judgment severity in the harm domain for moderately severe violations in particular. We again also tested for an interaction with the individual-difference variable of awareness of one's bodily sensations.

2.6.1   Study 6: Method

Participants and Procedure

502 undergraduate students participated in exchange for course credit. 13 participants were excluded due to procedural errors, for a final sample of 489 (74% women, $M_{age} = 20.17$, $SD = 3.07$). Participants followed a procedure identical to that used in Study 3. Sample size was determined in part from a power analysis based on 75% power to detect a small interaction effect, and in part by aiming to collect as much data as possible until the end of the school semester even if that meant including a sample slightly larger than the calculated estimate.

Materials

Prior to data collection we pre-tested a set of harm infractions for their severity. These vignettes were modified slightly from past research (i.e., Knutson et al., 2010). To pre-test the

severity of these 12 vignettes, seven undergraduate research assistants read and rated each on a 9-point Likert-scale ranging from 1 (*Perfectly OK*) to 9 (*Extremely Wrong*). We then selected 4 highly severe and 4 moderately severe moral violations for inclusion (see Appendix E; ICC for all items = .68; ICC for selected items = .51): M_{High} = 7.64 (*SD* = .63); $M_{Moderate}$ = 4.25 (*SD* = 1.59), paired-sample *t(6)* = 5.44 *p* = .002. We again separately analyzed responses to highly and moderately severe moral harm violations and predicted that ginger would be most effective for reducing responses to moderately severe infractions.

2.6.2   Study 6: Results

Participants judged the highly severe harm violations to be significantly more wrong than the moderately severe harm violations, M_{high} = 7.80, *SD* = .83; $M_{moderate}$ = 5.27, *SD* = 1.29; paired-sample *t(488)* = 46.05, *p* < .0001. We again separately examined results for moderately and highly severe violations. For moderately severe violations, neither an interaction between bodily sensation awareness and experimental condition, *b* = .20, *t(485)* = 1.43, *p* = .15, nor a main effect of condition, *b* = -.06, *t(485)* = .50, *p* = .62, emerged; M_{ginger} = 5.24 (*SD* = 1.31); M_{sugar} = 5.29 (*SD* = 1.26), independent sample *t(487)* = .43, *p* = .67. Similarly, no main effect of bodily sensation awareness emerged on judgments of moderately severe harm violations, *b* = .08, *t(485)* = 1.12, *p* = .26.

Turning to the highly severe violations, neither an interaction between bodily sensation awareness and experimental condition, *b* = .018, *t(485)* = .20, *p* = .84, nor a main effect of condition, *b* = -.06, *t(485)* = .75, *p* = .45, emerged; M_{ginger} = 7.95 (*SD* = .85); M_{sugar} = 8.00 (*SD* = .82), independent sample *t(487)* = .67, *d* = .06, 95% CI [-.24, .12], *p* = .51. Similarly, no main effect of bodily sensation awareness emerged on these judgments, *b* = .06, *t(485)* = 1.28, *p* = .20. Importantly, there was no main effect of condition on participants' ratings of their trait bodily

sensation awareness, M_{ginger} = 4.30 (SD = .84); M_{sugar} = 4.18 (SD = .84), independent sample $t(487)$ = 1.55, p =.12.

We again examined whether participants' awareness of having ingested ginger might have influenced results. In total, 142 participants correctly guessed that they had ingested ginger and 56 incorrectly guessed that they had ingested ginger. By contrast, 20 participants incorrectly guessed that they had ingested sugar and 39 correctly guessed sugar. The remainder of participants reported not knowing which condition they were in. We re-ran the main analysis on moderately severe stimuli removing those participants in the ginger condition who reported knowing they had taken ginger, and similarly found no interaction between bodily sensation awareness and experimental condition on moral judgments of moderately problematic stimuli remained similar, b = .20, p = .26, no main effect of condition on judgments, b = -.09, p = .55, and no main effect of bodily sensation awareness, b = .04, p = .62. We similarly found no evidence of an interaction when excluding participants in both conditions who believed (some incorrectly) that they had taken ginger; b = .14, p = .45, no main effect of condition on judgments, b = -.09, p = .59, and no main effect of bodily sensation awareness, b = .09, p = .34. We also found no evidence of an interaction when excluding participants in both conditions who correctly guessed which condition they were in; b = .22, p = .23, no main effect of condition on judgments, b = -.06, p = .71, and no main effect of bodily sensation awareness, b = .03, p = .70.

2.6.3   Study 6: Discussion

Overall, we found no evidence that ginger reduced the severity of moral judgments to harm violations. These results, then, qualify the conclusion from prior studies that physiological feelings of nausea are causally related to moral judgments of moderately (but not highly) severe

moral violations – this phenomenon seems to be true for moral judgments made concerning purity, but not harm, violations.

2.7 Chapter 2 Discussion

The research presented in Chapter 2 represents the first attempt to pharmacologically inhibit the primary physiological component of disgust (nausea) and measure downstream consequences on feelings of disgust and moral judgments. It also provides the first experimental evidence that feelings of disgust which spontaneously occur in response to both moral and non-moral purity violations are rooted in physiological nausea, and are causally related to judgments of those violations. These findings therefore make several novel contributions to our understanding of disgust and its role in moral thinking.

First, they suggest that psychological feelings of disgust are at least partly caused by physiological nausea. Prior research has shown that nausea and disgust are both associated with neurological responses in the insula (Napadow et al., 2013; Wicker et al., 2003), a brain region activated by unpleasant tastes and odors (Small et al., 1999; Wicker et al., 2003). However, the insula is also associated with anger (Damasio et al., 2000), anxiety (Critchley et al., 2004), and somatosensory awareness (Critchley et al., 2004), limiting firm conclusions about the precise relationship between physiological and psychological disgust on this basis (see also Chapman et al., 2009). The current research is the first to demonstrate that nausea is causally connected to psychological disgust feelings. Although prior studies found an association between gastric precursors to nausea and self-reported feelings of disgust in response to non-moral purity violating stimuli (i.e., core disgust elicitors like dirty toilets; Harrison et al., 2010; Shenhav & Mendes, 2014), these studies did not test whether nausea was the cause of reported disgust

feelings. By inhibiting nausea via ginger, and observing consequent reductions in reported disgust to core elicitors, the present Study 1 demonstrates that physiological nausea causes psychological disgust. This suggests that psychological disgust is therefore not merely the cognitive perception of a stimulus as potentially nausea-inducing. This finding provides novel support for somatic theories of emotion. Somatic theories of emotion suggest that emotions are, in part, the result of subjective feelings of our physiological symptoms (Damasio, 1994).

Second, these findings are the first to show that biologically interfering with spontaneously occurring nausea in response to moral infractions reduces the severity of judgments about those infractions, providing the first evidence that integral disgust—that is, disgust regarding a particular moral violation, as opposed to incidental disgust resulting from an unrelated stimulus—influences judgments of that violation. Thus, the present findings add importantly to ongoing debates about the role of disgust in moral judgments. Although several researchers have argued that evaluations of moral violations are influenced by feelings of disgust (e.g., Eskine et al., 2011; Schnall et al., 2008; Wheatley & Haidt, 2005), all prior experimental studies supporting this view have used incidental disgust manipulations, in which extraneous feelings of disgust are induced via the presentation of a real or imagined noxious stimuli and entirely separate moral judgments are subsequently measured. This approach comes with several limitations and a recent meta-analysis has called into question the very existence of the effect itself. In the present research, we tackled the question of disgust's role in moral judgment in a different way by instead interfering with spontaneous disgust feelings in order to test whether subsequent judgments of that same infraction were affected. Findings generally support the

conclusion that interfering with disgust feelings reduces the severity of subsequent moral judgments of moral purity violations.

Additionally, by showing that reducing nausea influences subsequent moral judgments, the present results argue against the view that perceptions of harm solely drive purity-based moral judgments as some have claimed (e.g., Schein, Ritter, & Gray, 2016). Unless this interference somehow also reduced perceptions of harmfulness or nausea contributes to these perceptions as well (although Studies 2 and 6 suggest not), these findings are consistent with the conclusions previously inferred from studies using incidental disgust manipulations. That is, similar to prior work examining the impact of incidental disgust on moral judgments, the present approach examining integral disgust suggests that purity violations trigger physiological disgust experiences which are causally related to moral judgments.

However, these findings also raise questions for future work. Results from Studies 1, 2, 3, and 4 were somewhat inconsistent. For example, although we observed main effects of ginger in Studies 1 and 3, in Study 4 we instead found an interaction between ginger and bodily sensation awareness. While we cannot provide any definitive explanation for this pattern, it is consistent with prior studies manipulating incidental disgust, which have produced similarly mixed results, sometimes observing a main effect (e.g., Horberg et al., 2009) and other times no main effect but an interaction between bodily sensation awareness and disgust on judgments (e.g., Schnall et al., 2008; but see Johnson et al., 2016). This inconsistency between main effects and interactions with bodily sensation awareness has also occurred in the literature in the same group of studies (Schnall et al., 2008). Furthermore, other research on incidental disgust and moral evaluations has documented additional moderators, such as emotional differentiation (Cameron, Payne, & Doris, 2013) and mindfulness (Sato & Sugiura, 2014); other factors like current mood, and—in

the present case—individual differences in the digestive system—are also likely to influence results. Clearly, future studies are needed to seek the boundary conditions of these effects (see Schnall et al., 2015).

Nonetheless, given the theoretical consistency of these effects across studies, their robustness when excluding participants who might have been aware of the manipulation, and our reliance on pre-registered hypotheses it seems unlikely that this pattern of results could be explained as a series of Type 1 errors.

Future studies are also needed to uncover the specific biological mechanisms underlying ginger's effects. Although considerable evidence suggests that ginger reduces nausea and the tendency to vomit, the precise way in which this works is unknown (Singh, Yoon, & Kuo, 2016). Some studies suggest ginger might function by suppressing the release of the hormone vasopressin from the central nervous system (e.g., Lien et al., 2003); vasopressin has been found to play a role in social information processing and pathogen avoidance behaviors in rats (Arakawa, Arakawa, & Deak, 2010; see also Choleris, Pfaff, & Kavaliers, 2013; Kavaliers & Choleris, 2011). Similar to studies showing that Tylenol influences social judgments as an indirect result of its painkilling properties (Randles et al., 2015), the present work indicates that ginger influences disgust and purity judgments as an indirect result of its nausea-inhibiting properties, but more research is needed to examine the first step in this process, in both cases (i.e., it is not fully understood how Tylenol inhibits pain, nor how ginger inhibits nausea). In the present research, we found no evidence for effects on any emotions other than disgust, nor did we find any kind of calming effect, supporting the suggestion that these results are specifically due to ginger's influence on nausea and nausea-based disgust. Furthermore, ginger is used medicinally in place of other antiemetics, such as dimenhydrinate, both because other

antiemetics can increase drowsiness whereas ginger's side effects are minimal, and because ginger is more nausea-specific (Ernst & Pittler, 2000; Lien et al., 2003; Pongrojpaw, Somprasit, & Chanthasenanont, 2007). However, future research on moral thinking employing the present approach should seek ways of unobtrusively measuring disgust alongside moral judgments, to more directly test whether such feelings mediate the effects of ginger on judgments. This research therefore provides the first evidence that disgust is causally rooted in nausea, and that this specific physiological experience is causally linked to moral thinking.

However, it seems that disgust is not related to all kinds of moral thinking: we found no evidence that ginger reduced moral judgments toward harm violations, so, the present findings tentatively suggest disgust is selectively related to moral judgments specifically in the purity domain. This conclusion is tentative because not all domains in Moral Foundations Theory, such as authority, were tested in the studies presented in Chapter 2. Regarding the lack of evidence for an effect of physiologically based disgust on judgments of harm-based violations, in Study 2, we performed an initial (and somewhat underpowered) experiment examining the impact of ginger on harm violations, but failed to find conclusive evidence that ginger altered moral judgments in this domain. To follow this up, in Study 6, we pre-tested harm-based moral vignettes to be of high or moderate severity, so as to better test whether, as in all prior studies showing effects for ginger, our manipulation interfered with moral judgments of moderately severe stimuli only. In Study 6, we found no evidence that ginger had any effects on moral thinking about harmful transgressions. The question of whether harm-based moral infractions (e.g., theft, non-sexual physical assault) are influenced by feelings of disgust has been a topic of considerable debate. Our results suggest tentatively suggest that thinking about purity violations and thinking about harm violations may recruit different psychological mechanisms, with disgust playing a causal

role in the former but not the latter. That said, more research on this is needed for two reasons. First, it is difficult to draw firm conclusions from null effects, as we found in our study of moral harm violations. Second, prior research has found that incidental feelings of disgust cause harsher moral judgments in the domains of both harm and purity (although with much smaller sample sizes; e.g., Schnall et al., 2008).

In conclusion, setting these important directions for future research aside, the present studies provide the first evidence for a novel means of studying feelings of disgust, using pharmacological interference. By adopting this approach, we documented for the first time that the primary physiological component of disgust and its emotional experience are causally related, and that the physiology of disgust also appears to be causally related to moral judgments of purity violations. Results thus help address debates about the role of emotionally charged intuitive processes versus deliberative reasoning in generating moral judgments.

Chapter 3: Moral Judgment by the Disconnected Left and Right Cerebral Hemispheres: A Split-Brain Investigation

In this chapter, rather than testing for the presence of a critical role for non-linguistic processes in moral thinking, I instead test whether moral thinking can occur in absence of linguistic processes dominant to the left hemisphere. More specifically, I pit the importance of the ability to process the intent of an agent, preferential to the right hemisphere, against linguistic verbal reasoning processes which are dominant to the left hemisphere of the brain.

As alluded to in Chapter 2, typically *intent* holds a privileged role in moral judgments (Baird & Astington, 2004; Knobe, 2005). Individuals tend to evaluate intentional harms as more blameworthy and wrong than injuries that were caused accidentally, and even if no negative outcome occurred they hold individuals responsible if they meant to cause harm (Cushman, 2008; Ohtsubo, 2007; Young, Cushman, Hauser, & Saxe, 2007; Young & Saxe, 2008). For example, in one study, participants said it was impermissible for someone to attempt to poison her friend, even if her friend never actually gets poisoned (Young et al., 2007). Indeed, it is often the case that merely the attempt to commit a crime (wherein the intended behaviors are carried out) is enough to be convicted in a legal court (Fletcher, 1998).

Thus, a tell-tale sign of developmentally mature (i.e., adult-typical) moral judgments is the extent to which the actor's intent is considered (Piaget, 1932/1965; Zelazo, Helwig, & Lau, 1996). As such, a useful metric for adult-typical or mature moral judgments is to assess the extent to which individuals take into account the actor's intent in their assignments of moral praise and blame. It should be noted that the notion that intent is an important factor in moral judgments may be somewhat of a WEIRD phenomenon; that is, reflective of the psychological

processes associated with individuals from Western, Educated, Industrialized, Rich, Democratic (WEIRD) societies, and not necessarily that of other cultures (Henrich, Heine, Norenzayan, 2010). Indeed, prior work has shown that some kinds of moral issues that certain cultures care especially about, such as purity violations and their associated taboos (e.g., Haidt, Koller, Dias, 1993), are less sensitive to questions of intent, which are more pertinent to harm-based violations (Young & Saxe, 2011). In other words, whether or not a person intended to commit incest is typically seen as not pertinent to the question of whether the incest is morally wrong. So, it may be the case that the extent to which an actor's intent is taken into account is a reliable indicator of developmentally mature moral judgments in WEIRD contexts only.

Recent brain imaging studies have sought to reveal the brain regions that generate intent-based moral judgments. Consistent with the preferential lateralization of language to the left hemisphere (Gazzaniga, 1970; Zaidel, 1991), these linguistic moral judgment tasks have revealed that various regions of the left hemisphere are involved in moral reasoning, including but not limited to, the left medial prefrontal cortex, left temporal parietal junction (lTPJ), and left posterior cingulate (Gan et al., 2015; Li, Yang, Li, & Lie, 2016; Young et al., 2010; Young & Saxe, 2008; see also Samson, Apperly, Chiavarino & Humphreys, 2004).

However, it is the right temporoparietal junction (rTPJ), that appears to be critically involved in processing mental state information such as intention and belief (Young & Saxe, 2008), with recent work demonstrating that the rTPJ is not only correlated with intent-based moral judgment (Young & Saxe, 2009), but also necessary for it: transcranial magnetic stimulation (TMS)-induced disruption of rTPJ activity reliably increases reliance on outcomes instead of intention in typically developed adult participants' assignment of blame (Young et al., 2010). Consistent with this conclusion, a recent linguistic moral judgment study involving partial

and complete split brain patients – whose communication between hemispheres has been largely disconnected due to surgical severing of the corpus callosum – demonstrated that the disconnected left hemisphere generates moral judgments based primarily on outcomes alone (Miller et al., 2010). In other words, when the left hemisphere is isolated from the rTPJ, it cannot make adult-typical intent based moral judgments. That said, this language-based study of the left hemisphere also showed that the left hemisphere *is* still able to generate moral judgments (i.e., was able to reliably say how wrong something was), albeit with an undue emphasis on outcome when assigning moral blame. Interestingly, the fact that partial anterior callosotomy patients were also unable to produce intent-based moral judgments suggests that the rTPJ seems to depend critically on upstream input from the right frontal system (Miller et al., 2010).

Collectively these data demonstrate that the right hemisphere plays a critical role in the language dominant left hemisphere's ability to make moral judgments. To date, however, because the tasks used in these studies have been linguistic in nature, it is not known if the right hemisphere can perform intent-based moral judgments independent of the language dominant left hemisphere. In other words, it is not known whether the language dominant left hemisphere is necessary for adult-typical intent-based moral judgments. Critically, if the left hemisphere is found to be *unnecessary* (i.e., the right hemisphere is both necessary and sufficient), this would suggest that conscious language-based reasoning is *not* primarily causal of moral judgments. Furthermore, given that moral evaluation tasks are usually presented in a language-based format, it is not known how the disconnected left hemisphere will perform on a moral judgment task that does not draw on a linguistic system. That is, it is possible that left hemisphere moral judgment ability, when deprived of linguistic input, will be compromised. If, when input is non-linguistic, even simple moral contrasts performed by the left hemisphere are compromised (such as

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differentiating between an agent who caused a morally good outcome and one who caused a morally bad outcome), this would suggest that one explanation for the prior evidence suggesting the importance of conscious left hemisphere language-based reasoning in moral thinking is that most prior studies have utilized a linguistic format, thereby biasing language to be involved.

A study using a split-brain patient can shed light on these issues because in such individuals the two hemispheres are cortically disconnected. By using a video-based (non-linguistic) moral evaluation task, one can assess the intent-based moral judgments of the relatively non-linguistic right hemisphere independent of the left (Gazzaniga & Hillyard, 1971). In addition, the non-linguistic task will allow for a test of the moral judgment performance of the left hemisphere when it is placed on equal footing with the right hemisphere. That is, by using non-linguistic video stimuli, the left hemisphere will not receive the input in a format that is preferentially biased to it, as has been the case in most prior research examining the brain bases of intent-based moral judgments. Said differently, moral vignettes used in prior research were typically language-based, so, by default, language-based processes have had a testing advantage (e.g., Miller et al., 2010).

Therefore, I conducted a study involving a split-brain patient who was presented with nonverbal moral stimuli and then asked to evaluate the characters involved. The goal of this research was to examine whether the disconnected left and right hemispheres are each separately capable of generating intent-based moral judgments. If sophisticated moral judgments can be made by the linguistically impoverished right hemisphere alone, it would indicate that this hemisphere is necessary and sufficient for generating typical moral judgments, and therefore that conscious language-based reasoning is not a necessary factor in causing intent-based moral judgments. This research therefore has the potential to inform the overarching debate about the

role of intuitive versus conscious linguistic deliberative reasoning processes in generating moral judgments.

3.1 Study 7

To test the moral judgment of each cerebral hemisphere, the present investigation adapted a set of nonverbal morality plays; for instance, depicting a Protagonist being either intentionally or accidentally hindered in their pursuit of a goal. These plays were originally designed to test the sociomoral evaluations of preverbal infants (Hamlin et al., 2007; Hamlin & Wynn, 2011; Hamlin, 2013). The use of these simple nonverbal stimuli allowed us to test the moral judgments of the linguistically impoverished disconnected right hemisphere, and the disconnected left hemisphere's moral evaluation abilities in the absence of linguistic input.

3.1.1 Study 7: Method

We tested the split-brain patient J.W. on multiple sessions over a period of one year. Each session consisted of J.W. viewing several videos of morality plays in which there was always a Protagonist with some kind of unfulfilled goal, and two agents who acted on the Protagonist's goal. J.W. saw two main types of morality plays: (1) basic and (2) intent-specific. In basic morality plays, the relative moral value of the agents was distinguishable both by the characters' intentions and by the outcomes they caused, that is, each agent's intentions and outcomes always aligned. For example, one agent intended to help the Protagonist and succeeded in doing so, and the other agent intended to hinder the Protagonist and succeeded in doing so. In these cases, J.W. could correctly distinguish the characters by entirely ignoring intent and focusing solely on outcome, because the outcomes—helping or hindering, differed between the agents. These basic plays were included primarily as warm-ups to get J.W. used to the procedure at the start of each session and comfortable with the mechanics of the task, and they also served as short

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intermissions between various intent-specific morality plays. In the intent-specific plays, the relative moral value of the two agents was *only* distinguishable by intention. Each agent brought about the exact same outcome (helping or hindering) for the Protagonist, but their underlying intentions associated with that outcome differed. For example, in some scenarios an agent with antisocial intentions tried to hinder the Protagonist from achieving the desired goal but failed, so the Protagonist achieved a positive outcome; whereas the other agent with prosocial intentions tried to help the Protagonist achieve the goal and succeeded also resulting in a positive outcome. Thus, both agents are associated with a positive outcome, but only one agent had the positive intention to do good, and so distinguishing the agents' on the moral dimension requires an analysis of intent. In other scenarios, one agent accidentally harmed (or helped) the Protagonist, whereas the other agent intentionally was harmful (or helpful). Again, both agents are associated with the identical negative (or positive) outcome, but only one had a clear intention; the intention of the other agent who acted accidentally is ambiguous. A second way some scenarios were intent-specific is that, for some scenarios *both* agents were associated with an outcome *opposite* to that which they intended. For example, one agent tried but failed to help the Protagonist (resulting in a negative outcome) and the other agent tried but failed to hinder the Protagonist (resulting in a positive outcome). Here, if intent was ignored and evaluations were made only on the outcomes each agent was associated with, J.W. might be led astray, preferring an agent who had negative intentions over one who had positive intentions. Thus, in these scenarios, evaluating agents on the adult-typical moral dimension requires an analysis of intent. These intent-specific scenarios were therefore of primary interest.

For each moral judgment trial, J.W. watched one agent act on the Protagonist. On a second trial, he watched the other agent act on the Protagonist. These same two video events

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were then repeated, for a total of 4 trial events. J.W. was then presented with pictures of the two agents, one depicted on the top and one depicted on the bottom of a blank white screen. He was asked "who is nicer?" and asked to tap high or low on the table using either his left index finger (a movement initiated by the right hemisphere) or his right index finger (initiated by the left hemisphere; Gazzaniga, Bogen, & Sperry, 1967). By requiring J.W. to use a contralateral finger to provide a response, we were able to isolate responding to one hemisphere at a time. One hemisphere was tested at a time for an entire session, which consisted of 11 trials in total. We examined whether each hemisphere evaluated prosocial agents as nicer than antisocial agents – on both basic and intent-specific plays – beyond random chance of 50%.

Videos and pictures of the agents during test were presented inside Microsoft Powerpoint on a Macbook computer. J.W. watched the videos sitting in a chair about arm's length away from the screen. Although both hemispheres saw the videos, we were able to isolate which hemisphere was tested per session, using the contralateral index finger, which is controlled solely by one hemisphere, allowing responses to be isolated to one hemisphere (Gazzaniga, 1995). A session consisted of different basic and intent-specific morality plays (11 in total), with two basic plays coming at the beginning of each session as a warm-up to the task (not included in analysis) and three basic plays interspersed among six intent-specific shows.[3] Because we wanted to ensure that J.W. had processed each event, he saw each agent act on the Protagonist's goal twice

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[3] Rare trials in which one hemisphere tried to respond out of turn, or attempted to interfere with the response of the hemisphere being tested, were excluded from analysis.

in alternation before being asked which agent was nicer[4]. An artificial red curtain was used to separate the events.

The morality plays consisted of a combination of video recorded live-action puppets moving around on a black stage as well as animated shows created in Microsoft PowerPoint. Both across sessions and within morality plays, several factors were counterbalanced to keep J.W. from possibly associating certain traits (e.g., the color of a puppet's shirt) with the niceness or meanness of an agent. The identity of the agents was counterbalanced across show type and session number (e.g., whether the nicer agent wore a green shirt or a blue shirt), as was the order in which a particular agent acted (e.g., the nicer agent sometimes acted first or second), what side of the Protagonist they appeared on (left or right), and whether they were presented to J.W. on the top or bottom of a screen during testing (i.e., during the "who is nicer" question). We predicted that the right hemisphere (in part due to access to the rTPJ) would evaluate prosocial agents as nicer than antisocial agents – on both basic and intent-specific plays – above random chance of 50%. We further predicated that the language dominant left hemisphere, disconnected from the rTPJ, would choose between prosocial and antisocial agents on intent-specific trials at chance levels. We suspected the performance of the left hemisphere for basic plays in which agents could be distinguished from outcome alone would be above chance.

3.1.2   Study 7: Results

We found a significant difference between the overall performance of the left hemisphere and the right hemisphere, Fisher's exact test, $p = .005$ (see Figure 2). Specifically, J.W.'s right

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[4] On the last round of testing, an equal number of trials for each hemisphere, this was shortened to J.W. seeing each agent act on the Protagonist's goal once, rather than twice, in alternation, as J.W. was used to the general design by then. J.W.'s data mirrored those of the previous sessions.

hemisphere selected as "nicer" the relatively more prosocial agents both in the basic shows (8/8 correct, binomial test $p = .008$) and in the intent-specific shows in which the outcomes were matched but the underlying mental states of the agents bringing about those outcomes differed (20/26 correct, binomial test $p = .009$). By contrast, J.W.'s language dominant left hemisphere chose randomly on both the basic shows (2 out of 8 correct, binomial test $p = .29$) and the intent-specific shows (14/26 correct, binomial test $p = .85$).

Figure 2 – Moral judgment by the disconnected left and right hemispheres
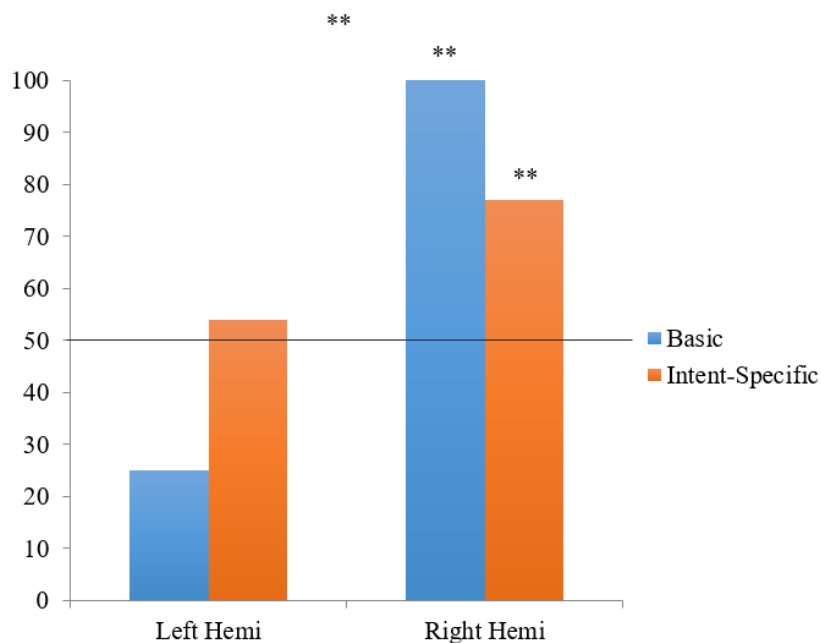
Note: The Y-axis represents the percentage of choices for the relatively nicer agent. For both hemispheres, responses to basic events are shown in blue bars and to intent-specific events in red bars. Performance of the left and right hemispheres differed. The right hemisphere demonstrated typical moral judgment (evaluating more prosocial agents as nicer) on both basic and intent-specific morality plays whereas the left hemisphere failed to distinguish the characters beyond chance levels for both event types. ** signifies statistical significance at $p<.01$.

For intent-specific shows, J.W.'s responding (for either hemisphere) did not depend on whether the valence of the outcome for the Protagonist was positive or negative, or whether the show depicted a failed attempt or an accident (*p*s>.30).

3.1.3   Study 7: Discussion

Our results indicate that the disconnected right hemisphere is capable of generating developmentally mature adult-typical intent-based moral judgments, evaluating agents with positive intentions as nicer and those with negative intentions as less nice. This finding fits with prior work showing a critical role for the rTPJ in generating intent-based moral judgements (Young et al., 2010). By contrast, the left hemisphere did not solve either basic or mentalistic moral contrasts. Our findings are the first to suggest that the combined workings of circuits in both cerebral hemispheres is not necessary for generating intent-based moral judgments. Rather, our results suggest that the right hemisphere is necessary and sufficient, and the language dominant left hemisphere is not necessary, for generating intent-based moral judgments, when moral stimuli are presented in a non-linguistic format.

Although this pattern of findings fit with prior results showing that the rTPJ is be important for incorporating intent into moral evaluations these results are also in some sense surprising. They are surprising given that generating moral evaluations based on others' intentions is a complicated feat, and the right hemisphere is in some sense, and especially linguistically, like that of a toddler. By contrast, the left hemisphere excels at many tasks relative to the right hemisphere, so the failure of the left hemisphere relative to the right is particularly interesting – but also raises some questions (Gazzaniga, 2000). One interesting question is: why did J.W.'s left hemisphere perform at chance levels on the basic events, in which one agent brought about a positive outcome and the other agent a negative outcome? In these scenarios,

because the outcomes associated with the two agents differed, no mental state analysis was required to demonstrate typical moral judgment. This result is seemingly in contrast with previous studies of split-brain patients' disconnected left hemispheres, which found that the left hemisphere was able to make reliable moral judgments by focusing on the moral outcomes, but tended to "ignore" intent (Miller et al., 2010). Importantly, the major difference between our study and Miller and colleagues (2010) is that their work presented intent-based scenarios linguistically to the left hemisphere whereas we used nonverbal stimuli. Our results suggest that the left hemisphere's performance is profoundly compromised when it is not presented with moral information in a linguistic format that is preferentially biased for it.

Indeed, some anecdotal evidence supports the notion that the non-linguistic format contributed to J.W.'s trouble with evaluating the agents. Although the evidence is rather limited, it may be the case that the left hemisphere selected non-moral behavior dimensions on which to base its judgments. That is, without linguistic information directly referring to moral acts, the left hemisphere may have misinterpreted the task and searched for other dimensions on which to base its responses. Indeed, past work suggests that the left hemisphere tends to over-search for detailed hypotheses with which to explain events, even when no patterns exist. For example, in a study utilizing a probability guessing game in which a dot randomly flashes in one location 80% of the time and another location 20% of the time, the left hemisphere failed to note the overall probability of dot flashes and instead tried to figure out the "pattern" at which dots appeared, even though none existed. In contrast, the right hemisphere did not search for specific patterns, and instead learned to maximize by repeatedly selecting the more probable location (Wolford, Miller, & Gazzaniga, 2000).

Anecdotal evidence supports this evaluation-dimension searching hypothesis, in that J.W.'s left hemisphere would sometimes attempt to justify his responses in non-moral ways. For example, when J.W.'s left hemisphere was asked why he chose a particular agent on one trial, his left hemisphere said that girls with blonde hair cannot be trusted, apparently ignoring the moral behavior the agent performed. On a separate trial, when asked why he chose one character, J.W.'s left hemisphere responded that it was because the box moved the most. Of course, it is difficult to say whether these linguistic reasons caused the left hemisphere judgments or were merely *ex post facto* verbal rationalizations for judgments made for other reasons (Funk & Gazzaniga, 2009; Haidt, 2001).

How do our findings fit into the broader literature examining the relationship between language and moral judgments? Our findings complement recent evidence in developmental psychology that suggest a linguistic system may not be necessary for generating moral judgments. That is, recent research with preverbal infants (some of it using the stimuli employed here) provides evidence for the view that a fully developed linguistic system is not necessary for generating what appear to be nascent moral judgments (or, at the least, social evaluations). For example, by around 3 months of age, preverbal infants look longer at a character who helped a climber get up a hill than they do at a character who prevented the climber from reaching the top of the hill (Hamlin, Wynn, & Bloom 2010). When they are able to start reaching for objects reliably (around 5-6 months of age) they selectively reach for helpful over unhelpful agents (in the same "hill" paradigm involving the climber and in other paradigms; e.g., Hamlin et al., 2007; Hamlin & Wynn, 2011). Infants' preferences for helpful over unhelpful individuals may be the result of a more general preference for prosocial over antisocial agents. For example, infants have been found to prefer a character who divides resources equally over a character who divides

them unequally (Burns & Sommerville, 2014; Geraci & Surian, 2011). Together, this growing body of evidence suggests that a well-developed linguistic system may not be a critical component involved in generating basic moral judgments involving decisions about whether agents are good or bad. Our work is consistent with this idea gaining traction in the developmental psychology literature and builds on it by showing that the moral judgments of an adult do not require an intact language-dominant left hemisphere.

In sum, the most striking aspect of our results is that the right hemisphere alone may be necessary *and* sufficient for generating normal intent-based moral judgments. This research therefore advances understanding into the neural systems supporting the human moral sense as well as moves forward the conscious linguistic reasoning versus moral intuition debate.

Chapter 4: General Discussion

4.1   Summary of Findings

In my dissertation, I sought to explore whether moral judgments are produced by rational conscious-language based processes without essential input from less rational and more emotional mental processes, or whether intuition and emotion have a critical causal role in moral judgment. I examined this broad question in two ways. First, I tested for emotion as a source of input in the process of generating moral judgments, by developing a novel method that allowed me to examine whether psychological disgust is causally rooted in physiological nausea and whether this response is causally related to moral judgments. Study 1 demonstrated that ginger, known to block nausea, also reduces feelings of psychological disgust (and not other negative emotions). Specifically, Study 1 demonstrated that ginger reduces feelings of disgust toward moderately severe offending stimuli, such as pictures of snot and rotten meat. Follow-up analyses in Study 1, the post-task disgust mediation results of Study 3 subsamples, and the main analysis in Study 5, in which the effects of ginger on fear was tested, suggest that the emotion-reduction effect of ginger was specific to disgust. These overall results demonstrate for the first time that the emotion of disgust is causally rooted in physiological nausea. What this suggests is not only that physiological nausea (at least in part) causes psychological disgust, but also that disgust is not merely the perception of a stimulus as potentially nausea-inducing.

This result is consistent with somatic theories of emotion such as Damasio's somatic marker hypothesis (Damasio, 1994), which suggest that at least part of what emotions are is subjective feelings of our physiological symptoms. This view, a modern day incarnation of the James-Lange theory of emotion, in which peripheral physiology causes the experience of emotion, is still of some debate. Some of the debate stems from the notion that the body proper

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cannot signal affective states with enough differentiation, given the rich variety of emotional experiences people report having (Dunn, Dalgleish, & Lawrence, 2006). While our results cannot speak at large to this debate—and the ginger studies were not designed to do so—at least in the case of disgust, our results suggest that its experience is at least partly dependent on physiological nausea.

Studies 3 and 4 used the same ginger manipulation to test whether nausea-based feelings of moral disgust are causally related to moral judgments involving moral purity violations. In Study 3, those participants on ginger made less severe moral judgments (toward moderately severe stimuli) than those on a placebo. This primary result of Study 3 suggests that nausea-based feelings of disgust, which spontaneously arise in response (i.e., are integral) to moral purity violations, are causally related to moral judgments of those violations. Findings between Studies 3 and 4 were somewhat inconsistent in that in Study 3 there was a main effect of the ginger manipulation but in Study 4 there was no such main effect but instead an interaction between condition and bodily sensation awareness, such that ginger severed the positive link between bodily sensation awareness and moral judgment severity. Although these findings are on the face of it inconsistent, they are also generally theoretically consistent: Interfering with disgust feelings reduced the severity of moral judgments of moderately severe purity violations. Together, Studies 3 and 4 suggest that disgust plays a causal role in moral judgments in the purity domain.

Studies 2, 3 and 6 examined whether nausea-based feelings of disgust are causally related to moral judgments in the domain of harm. Overall, findings across these studies provided no evidence that nausea-based disgust is casually related to harm judgments. More specifically, although in Study 2 ginger reduced deontological (emotion-based) responding to trolley dilemmas, this finding was not replicated in Study 3 with a much larger sample. Study 6 examined harm

violations using the same pre-testing to separate highly versus moderately severe violations, as was done in Studies 3 & 4's examination of judgments of moral purity violations. Despite this more pointed approach, which allowed us to directly examine the effects of ginger for moderately severe harm violations, we found no evidence that ginger reduced the severity of moral judgments toward harm violations, either as a main effect or in interaction with bodily sensation awareness, and either for highly or moderately severe harm violations.

Whereas in Chapter 2 of my dissertation I focused on emotion as a source of input in causing moral judgments, in Chapter 3 I tested whether moral judgments could occur in absence of left hemisphere dominant linguistic reasoning processes. Specifically, in Study 7, I examined intent-based moral judgments of the split brain patient J.W.'s right hemisphere, when disconnected from the language dominant left hemisphere. J.W. was presented with nonverbal morality plays that involved a main character trying to achieve a goal. This character was either helped or hindered by agents who either had positive or negative intentions. J.W. was then asked to choose which of two agents was relatively nicer. Critically, on some test trials, the "correct" answer could only be selected by incorporating the agents' *intentions* to help and hinder. Although it may seem that without access to the language dominant hemisphere the right might face difficulty generating moral judgments of complex moral situations involving agents' intentions, this was not the case. Instead, results showed that, when evaluating nonlinguistic stimuli, the disconnected right hemisphere made adult-typical intent-based moral judgments. By contrast, the moral judgment of the disconnected language dominant left hemisphere was markedly impaired, and did not generate reliable moral judgments to either basic or intent-specific stimuli. The main implication of the findings of Study 7 is that complex linguistic reasoning of the left hemisphere is not required to generate moral judgments of nonlinguistic stimuli, providing supporting evidence for the notion

that moral judgments are rooted in intuitive processes that can operate independently from left hemisphere dominant linguistic systems.

4.2 Limitations and Future Directions

The current research, however, should be considered only in light of its limitations. Perhaps the most salient limitation of the studies in Chapter 2 is that the main findings were somewhat inconsistent. In particular, the finding that ginger reduced the severity of moral judgments toward moderately severe purity violations emerged in Study 3 as a main effect but in Study 4 in interaction with bodily sensation awareness. This means, essentially, that the effects are not fully understood, for it is not known why in one case a main effect occurred but no interaction with bodily sensation awareness and in the second case no main effect occurred but there was an interaction between ginger and bodily sensation awareness. While this is undoubtedly an important matter for future research, the inconsistency found herein is similar to that found in research examining the effects of incidental disgust on moral judgments (e.g., Schnall et al., 2008), which sometimes find main effects of disgust and other times find an interaction between the disgust manipulation and bodily sensation awareness. To further explore these inconsistencies, future research should do more to examine whether the efficacy of ginger differs for certain individuals, which might help to explain the inconsistency between studies.

Prior work examining the impact of incidental disgust on moral judgment has found that one important factor in the likelihood of observing a main effect versus an interaction is the way in which incidental disgust is manipulated. Main effects seem to be more consistent when olfactory or gustatory manipulations are used whereas the effects are less consistent and often only come out in interaction with bodily sensation awareness when pictures or written manipulations are used (Schnall et al., 2015). In the present research, we inhibited integral disgust to written manipulations

of potentially disgusting moral stimuli. Given this difference between our work and past work, it is unclear whether this explanation of inconsistent findings has bearing on the differences across studies we found. That is, whether this explanation holds true for pharmacological manipulations that inhibit integral disgust feelings toward such stimuli is unknown and a worthwhile avenue for future research.

A second limitation of the ginger research concerns the interpersonal harm items used. We consistently found no effects of ginger for interpersonal harm. However, some of the items used in Study 6 might have tapped into other moral domains in addition to tapping into concerns about interpersonal harm (see Appendix E). For example, one of the moderately severe harm items concerns a daughter who hangs up the phone on her mom during an argument. While participants might have thought that a daughter hanging up the phone on her mom might cause some social pain to the mother, and thus have elements of interpersonal harm, they may also have perceived this action to be a violation of authority – since the daughter's potentially harmful and/or disrespectful action is directed against her the mother. Similarly, one of the highly severe harm violation vignettes used in Study 6 involved a man failing to uphold his end of a trade by not sending an item to someone who had already paid him for it over eBay. While this transgression may harm the other person financially, it is also unfair. According to Moral Foundations theory, Fairness/cheating is a separate moral foundation distinct from that of harm; these fairness concerns are thought to be part of a suite of psychological responses geared to promote reciprocal altruism and are theorized to generate ideas such as rights and justice – and may not recruit the emotion of disgust as strongly as other emotions, such as anger; Haidt & Joseph, 2004; Rozin et al., 1999; Trivers, 1971). Because in Study 6 harm vignettes potentially contained elements of other moral domain concerns, the question of whether disgust is casually related to moral harm violations may

not have been as cleanly addressed compared to in the studies examining disgust in the purity domain.

That there may have been some degree of overlap of potential moral concerns in what were meant to be the harm items is interesting because the content of all those items was pulled directly from prior research in which participants were asked to report on real situations where they committed a moral violation, and all of these were coded by the researchers as having at least some element of harmful consequences, suggesting these vignettes likely activated at least some concern about harm (Knutson et al., 2010). This suggests that real life moral transgressions may frequently activate more than one moral domain concern. An interesting avenue for future research in moral psychology, then, would be to examine how people evaluate violations that have elements of multiple domain violations versus those that cleanly violate a single domain. It could be that one moral domain overrides judgments of another, becoming the focal action on which a judgment is produced. For example, perhaps for some individuals, interpersonal harm violations are most salient and other morally relevant content is ignored. To take an unlikely example that can help make the point, consider a transgression where someone burns his or her country's flag that is wrapped around another person, burning the person in the process. In this hypothetical case, perhaps the moral judgment is calculated entirely on the basis that some kind of harm occurred to a victim, with none of the judgment calculated from the fact that this person also happened to burn his or her country's flag. Or, moral judgments of transgressions that violate multiple domains could be calculated additively. That is, it could be that the more moral domains violated in a single act, the worse the resultant judgment of that act. It would interesting also to know how emotions and intuitions interact with deliberative reasoning processes to reach judgments of multi-domain moral violations.

A third limitation or perhaps future direction of the research in Chapter 2 is that, because only one dosage of ginger was used, it is not known whether the effects of ginger on disgust and moral judgment are dose dependent. The research in Chapter 2 also only used a single intervention (i.e., a single dose). While some research examining the efficacy of ginger for reducing nausea and vomiting used a single dose (e.g., Lien et al., 2003), other studies have employed several smaller doses over the course of days (e.g., Ryan et al., 2012), or several small doses in a single day (e.g., Borrelli, Capasso, Aviello, Pittler, & Izzo, 2005), before examining ginger's efficacy. It is possible that the effects of ginger would be stronger or would work on stimuli of a higher severity if consumed several times before test, or at a different dosage amount. Future research should therefore test ginger's effects at different doses (e.g., 1 versus 2 grams), and interventions (e.g., single versus daily dose).

Although the post-task emotion measurement results of Study 3 subsamples suggest that disgust mediated the effect of ginger of moral judgments, they are limited by the fact that they are not a direct measure of emotional feelings in direct response to the stimuli. Thus, a fourth limitation is that, other than these post-task mediation results of Study 3, we did not obtain a direct measure of feelings of either nausea or disgust in response to the moral violations, but rather inferred mediation from prior research on the effects of ginger, the correlational relationship previously documented between moral disgust and moral judgment, and by ruling out alternative explanations such as that ginger acted on negative affect or arousal. It would therefore be interesting and useful to know whether ginger reduces self-report feelings of nausea upon exposure to disgusting stimuli or moral violations. Our thinking in designing these studies was that assessing self-reported disgust in response to the moral violations would be problematic, because asking participants about their emotional responses toward stimuli can influence subsequent judgments (e.g., Lapate, Rokers, Li,

& Davidson, 2014; see also Schnall et al., 2015; Schwarz, 2012), and asking about disgust in particular could prime feelings of disgust that might not otherwise exist. In our view, however, we were able to demonstrate indirect mediation of disgust, in a manner similar to the experimental causal-chain approach put forth by Spencer, Zanna, and Fong (2005). In particular, in Study 1 we documented that ginger, known to reduce nausea, also reduces feelings of psychological disgust. In Studies 3 and 4 we found that ginger also has an effect on moral judgments. While the latter effect could be due to some property of ginger other than its effect on nausea and disgust, this seems unlikely given that there is no evidence to suggest that ginger has any effect on other negative emotions or arousal more broadly, and a large literature has linked feelings of disgust, specifically, to moral judgments (e.g., Gutierrez & Giner-Sorolla, 2007; Horberg et al., 2009; Inbar et al., 2009). Furthermore, even if we had measured disgust feelings toward the moral vignettes alongside judgments of moral wrongness, one might reasonably argue that any evidence of mediation would be merely correlational, and thus possibly due to moral beliefs influencing self-reported disgust, or even ginger influencing both judgments of wrongness and disgust feelings simultaneously (see Spencer, Zanna, & Fong, 2005). Future studies are therefore needed to unobtrusively measure nausea and disgust feelings in response to the moral violations to more directly test for mediation.

A related and fifth limitation is that it is unknown exactly how ginger acted to have its effect. Although the exact means of ginger in nausea-reduction is unknown, there are a couple viable candidates based on the evidence. One possibility is that ginger reduces the release of vasopressin from the central nervous system. Vasopressin is thought to play a role in causing nausea. One study showed that those on ginger were found to have less vasopressin in their blood plasma and reported feeling less nauseous after motion sickness manipulation than those on a

placebo. This study also found that injecting individuals with vasopressin induces nausea and that the amount of nausea experienced from vasopressin injection by those on ginger and placebo was statistically the same (Lien et al., 2003). Interestingly, vasopressin has been found to play a social role in disease avoidance in rats (Arakawa et al., 2010; although this is unlikely to be such a straightforward explanation given that vasopressin is part of a complicated system with multiple receptor types, and much is still unknown about vasopressin in humans; Insel, 2010). A second possibility is that ginger acts peripherally on the gut, affecting the contractions that are precursors to nausea. (Holtmann, Clarke, Scherer, & Höhn, 1989; Grøntved & Hentzer, 1986). In addition to discovering how ginger acts to reduce nausea, uncovering the precise underlying biological causal chain behind how ginger acts on psychological disgust is also an important matter for future research. Doing so may help to further elucidate how physiological symptoms from the body proper contribute to moral cognition. Of course, there is no reason that ginger needs to have just a single mechanism of action: a third possibility for ginger's mechanism of action is that ginger works to reduce nausea through a combination of central and peripheral mechanisms.

The research in Chapter 3 also had limitations. One being that, due to the difficult nature of recruiting split brain patients, we were only able to study a single patient. This makes it difficult to draw firm conclusions about the extent to which the results from Study 7 can be generalized to the broader population's normal brain functioning. In addition, although we utilized stimuli previously validated in an infant psychology laboratory, the events depicted were relatively benign compared to the moral issues adults more commonly consider and give weight to. Had we shown J.W. nonverbal moral violations of a more serious nature (e.g., attempted murder instead of the attempted blocking of a desired goal object), it is possible that we would have seen different results, particularly in the left hemisphere. That said, I can think of only one reason for *why* the results

would turn out different with stimuli of different severity in this case – and it does not seem particularly likely. One possibility is that the task was too easy for J.W.'s left hemisphere, and thus his left hemisphere 'tuned out' from incorporating the agents' moral behaviors and intentions when asked to report which agent was nicer. Future studies therefore should develop additional nonverbal stimuli that depict more serious moral violations than those used here. It is telling that even though such minor transgressions were used we were still able to detect differences in the moral judgment capacity of the two hemispheres. Another limitation is that, although we isolated J.W.'s responding to each hemisphere by having him generate responses using his contralateral index finger, both hemispheres saw the moral scenarios presented, so it is possible that subcortical networks in the contralateral hemisphere contributed signals to the opposite hemisphere, which might have had an impact on the ultimate behavioral judgment delivered via the index finger. Future studies should thus seek to replicate the results of Study 7 with the nonverbal visual stimuli isolated to one hemisphere at a time to ensure that neither hemisphere is having subcortical any influence on the other.

A third limitation of Study 7 is that we were not able to fully explain the left hemisphere's failure to generate reliable moral judgments to the basic shows in which one character with prosocial intentions brought about a positive outcome for the Protagonist and another character with antisocial intentions brought about a negative outcome for the Protagonist. It might have been illuminating to present the morality plays also in a linguistic format in order to assess whether the language dominant left hemisphere can generate adult-typical moral judgment when violations are presented linguistically. Without this comparison it is difficult to know whether a) the left hemisphere is completely unable to evaluate moral stimuli presented nonverbally, b) whether as mentioned prior the left hemisphere did not view the depicted actions as moral transgressions

because they were too benign or c) being cut off from the rTPJ prevented moral evaluations from occurring. Because we did not test the left hemisphere linguistically with written versions of the stimuli, we cannot answer this empirically. Thus, a useful avenue for future research on the topic of split-brain patients' moral judgments would employ both linguistic and nonlinguistic versions of the moral transgression stimuli to each hemisphere.

A fourth limitation of Study 7 is that we were only able to examine the importance of the language dominant hemisphere 'online' so these results do not speak to the importance of conscious linguistic reasoning as a developmental process for shaping the moral judgment system over time. It is possible that the language dominant left hemisphere plays a critical role in the developing moral judgment capacity of the immature right hemisphere early on in development, but that the right hemisphere becomes fully capable of generating moral judgments independently in adulthood. This may be true if processes in the left hemisphere play an important role in generating moral rules (such as "do not hold the intention to block other agents' goals"), that are later expressed by a subset of neural processes that are not isolated to the left hemisphere. There is some evidence against this view, however, with regards to moral judgments. As mentioned in the introduction of this chapter, prior research has applied TMS to disrupt neural activity in the rTPJs of typically developed adults. This research found that disrupting neural activity in the rTPJ led individuals to downplay the importance of intent in their moral judgments (Young et al., 2010). This suggests that neural circuits involved in processing intent are important for generating 'online' moral judgments. And this makes some sense: the stimulus is likely to be perceived differently if individuals are unable to process the agent's intent as they encode the scenario. Of course, that assumes that TMS to the rTPJ is disrupting encoding of intent and not doing something else.

4.3   Broader Implications

Despite the limitations of these studies, their findings have several implications for the literature on human moral judgment. First, these findings argue against recent claims that emotions are not an important source of input in the moral judgment process. We in contrast found that the emotion of disgust plays a causal role in generating moral purity judgments. Our findings do not imply, however, that disgust is sufficient for generating moral judgments. As others have pointed out, the relationship between disgust and moral judgment is not always a simple one: for example, we find some things disgusting but not immoral – so there must be other processes involved that help to dictate whether something is *immoral*, as opposed to just aversive (such as a baby's poop; e.g., Pizarro et al., 2011). Likewise, because we found no evidence that integral disgust is causally related to moral judgments in the harm domain, it tentatively seems that we find some things immoral but not literally disgusting. So, whatever the relationship between disgust and moral judgment, it clearly is not a simple 1:1 mechanistic one.

One thing the disgust studies cannot speak to is the role of intuitive processes for evaluating morally praiseworthy actions. Indeed, the entire field of moral psychology itself can speak less to this as studies more commonly have examined evaluations toward negative rather than positive moral acts (Algoe & Haidt, 2009). By contrast, the research in Chapter 4 involved both morally praiseworthy and blameworthy actions. In this research, we found that the disconnected right hemisphere, in the absence of significant input from the language dominant left hemisphere, successfully generated adult-typical evaluations of morally praiseworthy and blameworthy acts. This tentatively suggests that the results of my dissertation have implications for understanding the underlying psychological processes involved in generating both moral praise and moral blame – though more research on the mechanisms of moral praise is surely needed.

Although the evidence in my dissertation generally favors a causal role for intuitive processes in the generation of moral judgments, reasoning processes are also very likely of importance for human morality. Regarding this view, theorists have noted that language and reason are the best candidate mechanisms that can explain how moral progress and change occurs over time. For example, people in the United States once viewed slavery as a moral right, but today unanimously view slavery as morally abhorrent (Bloom, 2004). If moral judgments were largely the result of fast, knee-jerk, automatic, intuitive, and emotion-based processes, and were not subject to input from linguistic reasoning, it would seem that moral judgments would not shift so drastically over time. That said, it is also possible that linguistic reasoning and emotion interact to produce moral progress/change: Linguistic reasoning and conversation with others may change the information one focuses on when having an emotional reaction, which may ultimately cause the shifts morality over time. For example, we find killing others – and even engaging in mock physical assault, emotionally aversive (Cushman, Gray, Gaffey, & Mendes, 2012) – and it may be that this emotional response plays a causal role in moralizing the act of killing or inflicting pain onto fellow humans. To get around the tendency to find killing emotionally aversive, a common tactic in war has been the de-humanization and demonization of the enemy. This functions essentially to change the properties of the stimulus being acted on (a fellow human becomes a demon) so that the aversive emotional response is less activated, or less likely to be activated, in response to killing – whereas other emotions, such as anger and fear, are more activated. In World War II for example, the United States engaged in propaganda tactics depicting the Japanese as demons, and the Japanese used very similar techniques demonizing people from the United States; this propaganda worked to devastating effect: Japanese villagers were documented to have thrown

themselves and their babies off cliffs to their deaths rather than face being captured by the evil US soldiers (Toland, 2011).

Relatedly, some have suggested that even if automatic intuitions are primarily causal of moral judgments 'online', prior conscious deliberative reasoning can still have an indirect causal role. For example, through deliberative reasoning, one can choose what kinds of situations and stimuli one will likely be exposed to in the first place, thereby biasing whether and which intuitions will be activated. Additionally, there is the well-known phenomenon of cognitive reappraisal, which involves deliberatively changing one's underlying thoughts about stimuli one perceives, so as to alter one's emotional driven intuitive response to it (Pizarro & Bloom, 2003).

Switching gears, one potential broader implication of the research in Chapter 2 has to do with the finding that ginger alters moral judgments and is also a widely-consumed food substance. Given the commonness in which ginger is consumed, and that people in different cultures consume different amounts of ginger, it would be interesting to examine whether any cultural variation in moral judgments is explained by cultural variation in the consumption of ginger. I am skeptical that such a study would produce a negative correlation whereby the more ginger a culture consumes the less severe their moral judgments – but it is certainly a line of inquiry which opens up directly as a result of the research in Chapter 2.

Although the evidence in my dissertation generally supports intuitive models of moral judgment, in that intuitive inputs were found to be important in the moral judgment process, there are a few caveats to make. The first caveat is that, as I mentioned in Chapter 1, it is certainly possible that both linguistic deliberative reasoning and intuitions play causal roles in generating moral judgments – either both playing a role for generating moral judgments of violations in a single domain or by having different degrees of importance for different domains

of morality. The extent to which linguistic deliberative reasoning or intuitions play a role in the moral judgment process also may depend on what one means by 'process', since this term can mean different things.

There is a moral judgment process that occurs 'online' when perceiving a moral transgression. This process is the underlying computations that occur in the brain during the moments after perceiving a moral transgression right prior to the production of the moral judgment, which generates the moral judgment. However, the computations involved in that process are likely influenced by the individual's past experiences – which means that the moral judgment process can either be described as consisting only of an online component (the computations that occur upon exposure to the stimulus) or, as having both an online component and a component based on prior experiences that shapes how the online process operates. This is another way of saying that brain operations in response to stimuli do not exist in the present moment in a vacuum; instead, responses to the current environment can depend on experiences from past environments. Regarding the moral intuition versus linguistic deliberative reasoning debate, moral intuitions one holds may depend in part on their developmental history, and their developmental history may in part depend on how their conscious deliberative reasoning processes impacted that developmental trajectory. For example, in a hypothetical case, one's deliberative reasoning may contribute to the decision to regularly socialize with a certain people. This group might consist of individuals who think that, if they cannot afford to buy bread, it is morally acceptable to steal it from the grocery store to feed their families. Through this social environment, which one decided to enter into through deliberative reasoning, one's intuition may be shaped such that stealing in some (Jean Valjean-esque) circumstances is morally acceptable.

The most striking example of one's prior developmental history shaping their online moral sense involves individuals who sustained damage to the ventromedial prefrontal cortex (vmPFC) at different ages. The vmPFC is a region of the brain that plays a significant role in processing internal feelings of emotion. Those who sustained vmPFC damage as adults demonstrate typical moral judgment and reasoning abilities but demonstrate impaired moral behavior in novel situations. This suggests that because they had access to a fully emotional system across their development, they were able to internalize moral rules conceptually, but are now unable to use emotions 'online' in the moment to inform their own moral behavior in these novel settings. However, individuals who sustained vmPFC damage in infancy or young childhood showcase *both* impaired moral behavior in novel settings *and* impaired moral judgment and reasoning ability (Anderson, Bechara, Damasio, Tranel, & Damasio, 1999; Damasio, 1994; Damasio, Tranel, & Damasio, 1990; Taber-Thomas et al., 2014). This suggests that without access to their emotional system from childhood, individuals in this early lesion group were impaired in their ability to learn conceptual moral rules (unlike the adult onset group)– so, their prior experiences (in which they did not have access to a critical emotional system) shaped their online moral judgment years later. Although this is a clinical example, it is possible that individuals' conscious deliberative reasoning may, for myriad reasons, lead them to have a more or less active emotional system in response to certain morally relevant stimuli. To continue the bread stealing example, someone whose deliberative reasoning led them to socialize with bread thieves may not have an emotional response that triggers a wrongness judgment upon witnessing someone stealing bread. If so, then in a sense this conscious deliberative reasoning might play a causal role in moral judgments, albeit with a developmental delay between cause and effect.

All this is to say that there are a number of caveats when attempting to draw conclusions from any single line of evidence about the role of conscious language-based reasoning versus intuition in causing moral judgments. Still, it is a convenient way to frame the problem and it is still a sensible question to ask so long as these underlying complexities are kept in mind.

4.4   Conclusions

In my dissertation, I have provided evidence that intuitive processes play important roles in generating certain kinds of moral judgments. Although the evidence supporting intuitive moral psychology has recently been under much scrutiny, my data suggests that intuitive processes – both the emotion of disgust and circuitry in the right cerebral hemisphere (which is largely independent of complex linguistic processes dominant to the left hemisphere), are critically involved in generating moral judgments. However, as reviewed, because both studies of morality using ginger as a manipulation and studies of the morality of split-brain patients are both relatively new areas of inquiry, much more research is needed on these topics to further elucidate the nature of human moral judgment. Still, it is my hope that this research can help resolve ongoing debates about the psychological processes that underlie moral judgments, a debate that is not only of theoretical, but also applied import.

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Appendices

Appendix A Body Consciousness Questionnaire

The Private Body Consciousness (PBC) Subscale of the Body Consciousness Questionnaire was

used to measure dispositional bodily sensation awareness. Specifically, participants answered the

following PBC items on a scale from 1 (*Disagree strongly*) to 6 (*Agree strongly*):

1. I am sensitive to internal bodily tensions.
2. I know immediately when my mouth or throat gets dry.
3. I can often feel my heart beating.
4. I am quick to sense the hunger contractions of my stomach.
5. I am very aware of changes in my body temperature.

Appendix B   Harm Vignettes Used in Study 2

A. James is going to work and considers whether to walk the 1½ miles or to drive in. He is feeling lazy and decides to drive in. How moral or immoral do you, personally, find James's decision to be?

> 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

B. Controversy has erupted over a documentary film about Mexican immigrants. The film has received excellent reviews, but several of the people interviewed in it have objected that their rights were violated. The filmmaker deliberately had his camera crew stand back 15 feet in a crowd so that some interviewees did not realize they were being filmed. Because the camera was not hidden, the procedure was legal. What do you think about the studio's decision to release this film, despite the aforementioned allegations?

> 1 (*Strongly approve of film release*) to 9 (*Strongly disapprove of film release*)

C. You are walking down the street when you come across a wallet lying on the ground. You open the wallet and find that it contains several hundred dollars in cash as well the owner's driver's license. From the credit cards and other items in the wallet it's very clear that the wallet's owner is wealthy. You, on the other hand, have been hit by hard times recently and could really use some extra money. You consider sending the wallet back to the owner without the cash, keeping the cash for yourself. How wrong is it for you to keep the money you found in the wallet in order to have more money for yourself?

> 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

D. You have a friend who has been trying to find a job lately without much success. He figured that he would be more likely to get hired if he had a more impressive resume. He decided to put some false information on his resume in order to make it more impressive. By doing this he ultimately managed to get hired, beating out several candidates who were actually more qualified than he. How wrong was it for your friend to put false information on his resume in order to help him find employment?

> 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

E. Your plane has crashed in the Himalayas. The only survivors are yourself, another man, and a young boy. The three of you travel for days, battling extreme cold and wind. Your only chance at survival is to find your way to small a village on the other side of the mountain, several days away. The boy has a broken leg and cannot move very quickly. His chances of surviving the journey are essentially zero. Without food, you and the other man will probably die as well. The other man suggests that you sacrifice the boy and eat his remains over the next few days. How wrong is it to kill this boy so that you and the other man may survive your journey to safety?

> 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

Appendix C   Trolley Dilemmas Used in Studies 2 and 3

Footbridge case

A runaway trolley is heading down the tracks toward five workmen who will be killed if the trolley proceeds on its present course. You are on a footbridge over the tracks, in between the approaching trolley and the five workmen. Next to you on this footbridge is a stranger who happens to be very large.

The only way to save the lives of the five workmen is to push this stranger off the bridge and onto the tracks below where his large body will stop the trolley. The stranger will die if you do this, but the five workmen will be saved.

Is it appropriate for you to push the stranger on to the tracks in order to save the five workmen?
   1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

Switch case

You are at the wheel of a runaway trolley quickly approaching a fork in the tracks. On the tracks extending to the left is a group of five railway workmen. On the tracks extending to the right is a single railway workman. If you do nothing the trolley will proceed to the left, causing the deaths of the five workmen.

The only way to avoid the deaths of these workmen is to hit a switch on your dashboard that will cause the trolley to proceed to the right, causing the death of the single workman.

How wrong is it for you to hit the switch in order to avoid the deaths of the five workmen?
   1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

Appendix D   Purity Violation Vignettes Used in Studies 3 and 4

Highly severe purity violations

1. Some U.S. states allow first cousins to marry each other. Other U.S. states are considering making marriage among first cousins legal. What do you think about such legislation?

   > 1 (*Strongly Support Legalization*) to 9 (*Strongly Oppose Legalization*)

2. How moral or immoral do you, personally, find consensual sex between first cousins to be?

   > 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

3. Frank's dog was killed by a car in front of his house. Frank had heard that in China people occasionally eat dog meat, and he was curious what it tasted like. So he cut up the body and cooked it and ate it for dinner. How wrong is it for Frank to eat his dead dog for dinner?

   > 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

4. Matthew is playing with his new kitten late one night. He is wearing only his boxer shorts, and the kitten sometimes walks over his genitals. Eventually, this arouses him, and he begins to rub his bare genitals along the kitten's body. The kitten purrs, and seems to enjoy the contact. How wrong is it for Matthew to be rubbing himself against the kitten?
   > 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

Moderately severe purity violations

1. A man who is not in a romantic relationship orders an inflatable sex doll that looks like his secretary. How wrong is this?

   > 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

2. A chemist has used special purifier materials to completely sanitize a person's feces. A man decides to eat a spoonful of the feces. How wrong is this?

   > 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

3. A man decides to drink water out a toilet bowl that has never been used. How wrong is this?

   > 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

4. When no one is looking, a morgue worker touches the open eye of a corpse. How wrong is this?

> 1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

Appendix E Harm Vignettes Used in Study 6

Highly severe harm violations

1. Jeremy put a poster that he had on EBay. There was a man who bid on it and paid with a system that sent the money directly to Jeremy. Jeremy thought the man was kind of a jerk during the whole transaction, so he decided not to send the poster and just kept the money.
    1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

2. Will used to drink and drive a lot. One time he borrowed his brother's car, was drunk and had taken Valium. He sideswiped another car that had its door open. Will got scared and kept driving.
    1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

3. When Jacob was graduating from high school, he had a friend whom he wasn't really getting along with anymore. He was coming to see Jacob when he got into a car accident. Jacob chose that time at the hospital to tell him their friendship was over.
    1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

4. Mary was in a store and found something she wanted, but it was expensive. She took it and put it in the box of an item that was cheaper, and paid for the cheaper item.
    1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

    Moderately severe harm violations

1. Derek had a good friend James who was a really nice guy. Then James got married and kind of changed. Derek didn't like James's new personality so when James called to hang out Derek would lie and say he was busy.
    1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

2. Jim used to work for the federal government. He used a calculator from work at home for some audits. When he left government services, he kept the calculator.
    1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

3. The other day Cindy got into an argument with her mom on the phone. She really doesn't like having to face the reality of her dysfunctional relationship with her mom. She was really mad at her mom so Cindy just hung up the phone.
    1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

4. Sarah was friends with Dave, whom her sister was dating. Sarah's sister didn't want Sarah to be friends with Dave because Sarah had dated him once. Sarah lied to her sister that she wasn't friends with Dave even though she hung out with him regularly.
    1 (*Perfectly OK*) to 9 (*Extremely Wrong*)

Appendix F   Description of Morality Plays Used in Study 7

Basic Shows

Box Show: In this show, a puppet (the "Protagonist") tried, with difficulty, to open the lid of a clear plastic box with a brightly-colored object inside. The Protagonist was alternately aided by a prosocial puppet (the "Helper"), who grabbed the side of the box opposite the Protagonist and helped to open the box, and thwarted by an antisocial puppet (the "Hinderer"), who slammed the box lid closed from the side opposite the Protagonist (see Hamlin & Wynn, 2011).

Ball Show: In this show, a Protagonist who played with a ball at the middle of a puppet stage, repeatedly jumped up and down and tossed and caught the ball. The Protagonist then lost its ball, which bounced to one side of the stage and was then retrieved by one of two puppets that rested at the back corners of the stage area. One puppet (the "Giver") gave the ball back to the Protagonist, while another puppet (the "Taker") ran offstage with the ball (see Hamlin & Wynn, 2011).

Hill Show: In this show, a Protagonist rest at the bottom of a hill before repeatedly attempting to climb up it. On the third climb attempt the Protagonist was either aided up by one puppet (the "Helper") who pushed it from behind, or was pushed down by another puppet (the "Hinderer"; see Hamlin, Wynn, & Bloom, 2007).

Shelf Show: In this show, a toy sat on top of one side of a wooden box. A Protagonist tried, with difficulty, to reach the toy on top of the box. The Protagonist was alternately aided by a prosocial puppet (the "Helper"), who leapt on top of the box, grabbed the toy, and dropped it down to the Protagonist, or was thwarted by an antisocial puppet (the "Hinderer"), who leapt on top of the box, grabbed the toy, and ran off stage with it.

Stack Show: In this show, a blue square platform lay in the center of the stage next to three blue circular shaped toys. In alternation, one of two events occurred. In one event, one Protagonist motioned back and forth between the platform and the toys and then attempted but failed to stack the toys of the platform. On the Protagonist's last attempt to lift the toys, a prosocial puppet (the "Helper") aided the Protagonist by helping to lift and stack the toys on the platform. In the other event, a different Protagonist motioned back and forth between the platform and the toys and successfully stacked the toys on the platform. After the toys were stacked, an antisocial puppet (the "Hinderer") ran up to the stacked toys and knocked them over.

Intent-Specific Shows

Accidental Helping: In this show, a toy sat on top of one side of a clear box; a second toy sat on the ground near the front of the box. After checking out the toy on the ground, a Protagonist tried, with difficulty, to reach the preferred toy on top of the box. The Protagonist was alternately aided by one puppet (the "Intentional Helper"), who ran up to the box and, using hands while facing the box, pushed it over so that the Protagonist could get the toy (and then proceeded to grab the other toy), or was "aided" by a puppet (the "Accidental Helper"), who, aiming for the

toy on the ground, bumped the shelf, knocking it over with the result that the Protagonist got the toy.

Accidental Hindering: In this show, a toy sat on the ground of one side of a clear box; a second toy sat on the ground near the front of the box. After checking out the toy on the ground, a Protagonist tried, with difficulty, to place a toy on top of the box. The Protagonist was alternately thwarted by one puppet (the "Intentional Hinderer"), who ran up to the box and, using hands while facing the box, pushed it over so that the Protagonist's toy was no longer atop the box (the Intentional Hinderer then proceeded to grab the other toy), or was "thwarted" by a puppet (the "Accidental Hinderer"), who, aiming for the toy on the ground, bumped the shelf, knocking it over with the result that the Protagonist's toy was no longer atop the box.

Failed Attempts, Both Agents Fail: In this show, a puppet (the "Protagonist") tried, with difficulty, to open the lid of a clear plastic box with a brightly-colored object inside. The Protagonist was alternately acted on by a prosocial puppet (the "Failed Helper"), who grabbed the side of the box opposite the Protagonist and tried to help to open the box but couldn't, and by an antisocial puppet (the "Failed Hinderer"), who tried to slam the box lid closed from the side opposite the Protagonist but failed to stop the Protagonist from getting the box open and the toy (see Hamlin, 2013). In this show, the "nicer" agent is the one who had good intentions (to help) but is associated with a bad outcome.

Failed Attempts, Successful Helper, Failed Hinderer: In this show, a puppet (the "Protagonist") tried, with difficulty, to open the lid of a clear plastic box with a brightly-colored object inside. The Protagonist was alternately acted on by a prosocial puppet (the "Successful Helper"), who grabbed the side of the box opposite the Protagonist and helped to open the box, and by an antisocial puppet (the "Failed Hinderer"), who tried to slam the box lid closed from the side opposite the Protagonist but failed to stop the Protagonist from getting the box open and the toy (see Hamlin, 2013). In this show, the "nicer" agent is the one who had good intentions (to help) and did so, despite that both agents' actions were associated with the same outcome (the Protagonist getting the toy).

Failed Attempts, Failed Helper, Successful Hinderer: In this show, a puppet (the "Protagonist") tried, with difficulty, to open the lid of a clear plastic box with a brightly-colored object inside. The Protagonist was alternately acted on by a prosocial puppet (the "Failed Helper"), who grabbed the side of the box opposite the Protagonist and tried to help to open the box but couldn't, and by an antisocial puppet (the "Successful Hinderer"), who thwarted the P the box lid closed from the side opposite the Protagonist but failed to stop the Protagonist from getting the box open and the toy (see Hamlin, 2013). In this show, the "nicer" agent is the one who had good intentions (to help) but is associated with a bad outcome.

Associated Hill: In this show, a Protagonist rest at the bottom of a hill before repeatedly attempting to climb up it. On the third climb attempt, the hill began to shake. As the hill was shaking, the Protagonist was either pushed down the hill by a rock that was directly pushed down the hill by an antisocial puppet, or, the Protagonist was pushed down the hill by a rock whose

falling was just associated with a puppet whom did not make contact with the rock (show modified from Hamlin, Wynn, & Bloom, 2007).

Wall Show: In this show, a large pillar or wall sat in the middle of the screen. In the Intentional Hinderer case, the Intentional Hinderer was on one side of the wall while the Protagonist was on the opposite side of the wall. The Intentional Hinderer moved to the other side and looked intently up at the Protagonist. The Intentional Hinderer then moved back in place, again on opposite sides of the wall to the Protagonist, and began to run up and push the wall, in an attempt to knock it over on top of the Protagonist. On the third attempt, the Intentional Hinderer successfully pushes the wall over on top of the Protagonist, who becomes squished and who displays a sad face. In the Accidental Hinderer case, the show is identical except that the Protagonist isn't on stage for much of the show. When the Accidental Hinderer moves around to look on the other side of the wall, the space is empty. The Accidental Hinderer looks upwards before moving back to other side of the wall. The Accidental Hinderer then ran up and pushed the wall, in an attempt to know it over. On the third attempt, the Protagonist entered from the left of the screen (i.e., in a different direction from where the Accidental Hinderer gazed when on that side of the wall) and was squished by the wall as it fell over, again displaying a sad face.