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Dissecting disgust : an investigation of the validity of the Three Domain Disgust Scale

Joshua Tybur

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Joshua Tybur

Candidate

Psychology

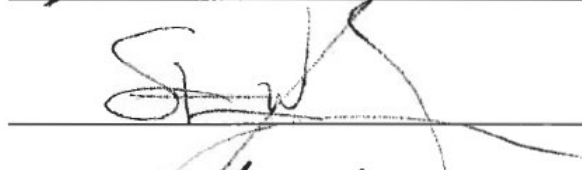
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Approved by the Dissertation Committee:



 Chairperson



Randy Thornhill



DISGUST DISSECTED:
AN INVESTIGATION OF THE VALIDITY OF
THE THREE DOMAIN DISGUST SCALE

BY

JOSHUA M. TYBUR

B.A., Psychology, Arizona State University, 2004
M.S., Psychology, University of New Mexico, 2006

DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
Psychology

The University of New Mexico
Albuquerque, New Mexico

August, 2009

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DEDICATION

To my parents, for all their support. I'm glad to have made you proud.

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Every member of my committee has helped me tremendously, both on this project and in the other work I've done in my five years in the graduate program. Geoffrey, thank you for all your personal support, your feedback, your prompt and thorough comments on my writing, your excellent teaching, and your creative ideas. Steve, thank you for your friendship, and thank you for lending me your experience in analyzing data, publishing, and reviewing papers. Randy, thank you for teaching me more about the basics of natural and sexual selection than I learned in any book I read. And Angela, thank you for teaching me how to review papers, and how to analyze data in several ways I hadn't thought of before.

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ABSTRACT

Research on the emotion disgust, and particularly individual differences in disgust sensitivity, has exploded in the past 15 years. However, most of this research has been based on outdated theory and poorly designed instruments. Tybur et al., (2009) suggested that past theoretical perspectives on disgust should best be updated in light of an evolutionary perspective, and measurement of disgust sensitivity should be developed based on an evolutionarily informed theory. After suggesting that disgust should be categorized along domains related to pathogens, sexuality, and morality, they introduced the Three Domain Disgust Scale, a new measure of individual differences in disgust sensitivity.

The current set of investigation aimed to advance knowledge of the validity of the Three Domain Disgust Scale. A first study demonstrated that the pathogen, sexual, and moral factors of the Three Domain Disgust Scale relates to Five Factor Model dimensions in a manner consistent with the theory under which the Three Domain Disgust Scale was developed. A second study demonstrated that only sensitivity to sexual disgust relates to political conservatism, but sensitivity to moral disgust relates to disgust reported toward ideologically conflicting ideas and figures within the political realm. A third study demonstrated that the Three Domain Disgust Scale measures three dimensions in both men and women, though the degree to which individual scale items measure these factors varies somewhat between the sexes. Results of these studies are discussed, as is the current state of knowledge of the validity of the Three Domain Disgust Scale, and potentially fruitful future research directions.

TABLE OF CONTENTS

List of Figures.....	xii
List of Tables	xiii
Chapter 1 Introduction.....	1
The Rozin perspective.....	4
Theoretical problems with the Rozin perspective.....	6
Empirical problems with the Rozin perspective.....	8
Other perspectives.....	11
Chapter 2 Pathogen Disgust.....	14
An emotional adaptation for avoiding pathogens.....	16
How to get an infection.....	18
Adaptive bias in pathogen disgust.....	21
Mismatches.....	23
Confusion regarding pathogen disgust.....	24
Chapter 3 Sexual Disgust.....	27
The importance of mating.....	27
Differentiating pathogen and sexual disgust.....	31
Cues for poor intrinsic quality.....	32
Cues for poor compatibility.....	33
Disgust toward specific sexual acts.....	35
Chapter 4 Moral Disgust.....	37
Is moral disgust really disgust?.....	37
The evolution of moral disgust.....	41

Moral disgust: Is it really moral?.....	42
Chapter 5 Individual Differences Across Domains.....	44
Chapter 6 Study 1: Disgust Sensitivity and the Five Factor Model.....	47
Method.....	52
Participants.....	52
Measures.....	53
Results.....	53
Discussion.....	58
Chapter 7 Study 2: Disgust Sensitivity and Political Ideology.....	61
Method.....	64
Participants.....	64
Measures.....	64
Results.....	65
How does the Three Domain Disgust Scale relate to conservatism?.....	65
How does political disgust relate to pathogen, sexual and moral disgust?.....	66
Discussion.....	69
Chapter 8 Study 3: The structure of the Three Domain Disgust Scale.....	75
Method.....	76
Participants.....	76
Results.....	76
Discussion.....	81

Chapter 9 General Discussion.....	84
Sensitivity to pathogen disgust.....	84
Sensitivity to sexual disgust.....	87
Sensitivity to moral disgust.....	89
Summary.....	91
Appendix A. Three Domain Disgust Scale.....	93
Appendix B. NEO-PI-3.....	94
Appendix C. Political ideology items.....	101
Appendix D. Political disgust items.....	102
References.....	103

LIST OF FIGURES

Figure 1. Publication rate of disgust articles.....	2
Figure 2. Disgust toward liberals as a function of sensitivity to moral disgust for conservatives and for liberals.....	68
Figure 3. Disgust toward conservatives as a function of sensitivity to moral disgust for conservatives and for liberals.....	69

LIST OF TABLES

Table 1. Correlations Between TDDS Factors and NEO-PI-3 Factors and Facets.....	57
Table 2. Bivariate and Semi-Partial Correlations Between Sensitivity to Disgust and Conservatism.....	66
Table 3. Unstandardized and Standardized Regression Weights Predicting Disgust Toward Liberals and Disgust Toward Conservatives.....	67
Table 4. Three Domain Disgust Scale factor loadings, variances, and covariances across the sexes.....	80

Chapter 1

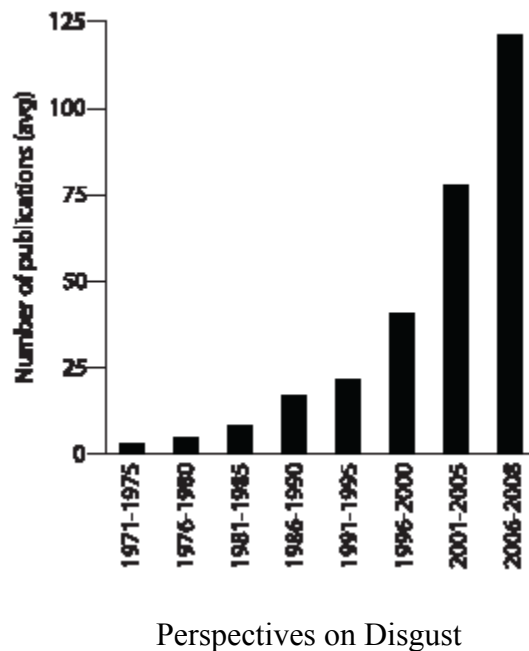
Introduction

In the family of emotions, disgust has recently graduated from neglected stepsister to a belle of the ball. From 1971-1975, the word “disgust” appeared in only 15 publications listed in PsychInfo. This increased to 25 from 1976-1980, 42 over the next five years, and 85, 110, 204, and 388 over the next four five-year spans (see Figure 1). This figure sits at 364 over the last three years alone (2006-2008). But despite the increased interest in disgust, several outstanding questions remain regarding how to best characterize the emotion. After all, disgust is elicited by foods, bodily wastes, some animals, bodily deformities, incest, bestiality, pornography, promiscuity, prostitution, ponzi schemes, and politicians. The wide variety of disgust elicitors – and the apparent lack of similarity between them – begs two critical questions: what function(s) does disgust serve, and how should the range of disgust elicitors be categorized? Currently, there are multiple answers to these questions. Some suggest that disgust is best perceived as a general protector of the self (e.g., Miller, 2004) whereas others suggest multiple specialized functions, each with their own elicitors (e.g., Haidt, Rozin, & McCauley, 1994).

In this manuscript, I summarize the existing, dominant perspectives on the function and categorization of disgust. I then summarize an alternative, more evolutionarily informed perspective introduced by Tybur, Lieberman, and Griskevicius (2009). I detail the psychometric properties of the Three Domain Disgust Scale, a measure of individual differences in disgust sensitivity developed by Tybur et al. (2009). I present three studies that evaluate multiple aspects of the validity of this measure. The

first study shows how sensitivity to these three domains of disgust relates to Five Factor Model personality dimensions; the second study shows how sensitivity to these three domains of disgust relate to political ideology; the third examines the factor structure of the measure, and how it operates across the sexes. Finally, I discuss how the three measures should be interpreted as theoretical constructs in light of the theory under which they were developed, the items that define the constructs, and the results of the studies included in this manuscript.

Figure 1. Publication rate of disgust articles



Starting with Darwin (1872), disgust has been conceptualized as one of the few basic, universal human emotions. Over time, researchers have gained a better understanding of what elicits disgust, how disgust covaries with other physiological responses, and how disgust manifests itself across cultures (Angyal, 1941; Eckman, Levenson, & Friesen; Plutchik, 1962; Tompkins, 1963). However, the wide variety of

seemingly unrelated concepts that elicit disgust has led to a lack of theoretical cohesion in explaining why the emotion operates in so many seemingly unrelated contexts.

Some perspectives have addressed the varied nature of disgust by proposing that it functions in a very general, protective manner. Miller (2004) views disgust as an emotion that ultimately functions to protect the self from anything undesirable. From this perspective, disgust toward phlegm serves the same purpose as disgust toward politicians: to keep polluting ideas and substances on the outside, and to keep purity on the inside. Similarly, Haidt, Rozin, McCauley, and Imada (1997) propose, “disgust is best understood as the guardian of the temple of the body” (p. 114), and Rozin, Haidt, & McCauley (2008) suggest that, although disgust originally evolved as a defense against pathogens, it has since developed into “a mechanism for avoiding harm to the soul” (p. 771).

Such perspectives are appealing for their inclusiveness. After all, at first blush, vomit, incest, and genocide don't seem to have much in common except for the fact that they all elicit disgust, and they all could be interpreted as threats to the self or soul. But this inclusiveness is also a weakness. Although it allows for a simple way to define disgust, it does not explain why certain concepts elicit disgust (e.g., hearing about Bill Clinton cheating on his wife) whereas others elicit guilt (e.g., cheating on your own spouse) and others elicit fear (e.g., being chased by your spouse after she discovered your infidelity). After all, guilt could be described as protecting the self by motivating corrective action after failure (Lewis, 1993), and fear could be described as protecting the self by motivating flight (Ohman & Mineka, 2001). Hence, it is unclear why some

concepts that threaten the self elicit disgust, whereas others elicit other emotions. A more nuanced approach – one that proposes more specific functions – may be more fruitful.

The Rozin Perspective

Paul Rozin and colleagues have significantly advanced the understanding of disgust by offering an account of how and why the emotion may have evolved, and how to categorize the emotion across different domains (Haidt, McCauley, & Rozin, 1994; Haidt, Rozin, McCauley, & Imada, 1997; Rozin & Fallon, 1987; Rozin, Haidt, & McCauley, 2000; Rozin, Millman, & Nemeroff, 1986). The most recent and comprehensive version of this perspective suggests that different disgust domains can be thought of in light of different stages of biological and cultural evolution (Rozin et al., 2008). From this perspective, disgust originally evolved from distaste (the “zero” stage), which functions to protect the body from food-based poisons, and is elicited by bad tastes. Selection then operated upon distaste to produce core disgust, the first stage, which functions to protect the body from disease, and is elicited by foods, body products, and animals. Rozin and Fallon (1987) argue that core disgust is one of four fundamental categories of food rejection (the others being distaste, danger, and inappropriateness).

Drawing from work by Becker (1972), Rozin et al. (2008) then suggest that animal reminder disgust evolved from core disgust as a defense against a fear of death present in all humans. Feeling disgust toward that which reminds us that we are animals – and thus mortal – “helps to suppress thoughts or experiences that suggest human mortality” (p. 761). Echoing this perspective, Goldenberg et al. (2001) argue “[d]isgust can be understood as the emotional protest against any reminder of our creatureliness, an affective assertion that says ‘I am fundamentally better than that’” (pg. 429). Under this

framework, disgust toward prototypical animal reminder elicitors – sex, death (e.g., corpses), bad hygiene, and envelop violations (cuts, wounds, and deformity) – does not serve the same food based, disease-avoidance function as core disgust. Rather, it functions to protect the soul by denying mortality.

The third stage of disgust is described as an interpersonal contamination domain, which is posited to exist based on observations that people are averse to touching objects used by strangers or individuals possessing a disease, a misfortune (e.g., an amputation), or a moral taint (Rozin, Markwith, & McCauley, 1994). Rozin et al. (2008) suggest that interpersonal disgust may be an adaptive response for reducing infection risk, but they ultimately conclude that it can be best described as functioning to “protect (the) body, soul, and social order” (p. 764).

Finally, Rozin et al. (2008) describe the fourth stage, moral disgust, which functions “to protect social order” (p. 764) and is elicited by certain moral offenses. They draw upon the CAD triad hypothesis (Rozin, Lowery, Imada, & Haidt, 1999), under which violations of three moral codes elicit three moral emotions: violations of community (e.g., fulfilling social obligations) elicit contempt; violations of autonomy (e.g., being just and fair) elicit anger; and violations of divinity (e.g., maintaining the purity and sanctity of the soul and body) elicit disgust. Examples of violations of divinity – and thus moral disgust elicitors – provided by Rozin et al. (1999) include eating rotten meat, an incestuous relationship, touching a corpse, biting into an apple with a worm in it, and a 70-year-old male who has sex with a 17-year-old female.

Disgust “stages” can be further deconstructed into disgust “domains.” Following work by Haidt et al. (1994), Rozin et al. (2008) state, “elicitors of disgust come from nine

domains: food, body products, animals, sexual behaviors, contact with death and corpses, violations of the exterior envelope of the body (including gore and deformity), poor hygiene, interpersonal contamination (contact with unsavory human beings), and certain moral offenses” (p. 757). However, little empirical or theoretical evidence suggests that disgust elicitors should be categorized along such domains.

Theoretical Problems with the Rozin Perspective

The Rozin perspective has many strengths. It proposes an evolutionary model through which disgust could have evolved into its current varied state, and it systematically categorizes disgust responses into different stages of evolution and different domains of elicitors. However, several empirical and theoretical issues limit the plausibility and utility of the perspective.

Foremost theoretically, the model suffers due to a lack of specification of what differentiates the purported stages and domains. For example, core disgust is the only domain explicitly referred to as functioning to protect against disease, but three of the four prototypical elicitors of animal reminder disgust (i.e., dead bodies, bad hygiene, wounds) are havens for infectious bacteria. Although interpersonal disgust is suggested to protect the body, soul, and social order, it is elicited by contact with other people, who are typically the ultimate infection vectors for other humans. And several of the moral disgust elicitors said to reflect violations of divinity – most notably contact with a corpse and eating rotten food – are clearly pathogen risks. For example, one elicitor – touching a corpse – could simultaneously be interpreted as disgusting because of a moral violation of divinity, because of interpersonal contamination, because dead bodies remind us that we are mortal, and because dead bodies are typically infested with bacteria.

The core, interpersonal, and moral domains each are posited to either protect against real or symbolic contamination threats, so conceptual overlap is not surprising. However, the animal reminder domain is suggested to fulfill a function relatively independent of disease-avoidance: it protects against the existential terror elicited by recognition of our state as a member of the animal kingdom. This perspective is problematic for multiple reasons. First, it is unclear why an animal reminder function need be invoked at all to account for disgust toward elicitors that share a common function with core disgust. Second, it has never been demonstrated that the disgust responses to purported animal reminder elicitors are any more similar than disgust elicitors grouped into the core disgust domain. Indeed, Tybur et al. (2009) demonstrate that self-reported disgust toward sexual concepts – one of the four elicitors of animal reminder disgust – shares no relationship with disgust toward other purported reminders of animality when disgust toward disease risks is controlled for. Third, it is unclear how a disgust response would neutralize reminders of animality or mortality. After all, disgust responses toward disease risks (e.g., feces) motivate behavioral avoidance, but they do not make one less aware of the presence of the disease risk. Similarly, disgust toward bad hygiene seems to motivate behavioral avoidance of the unwashed, but it does not seem to make one less aware of their presence.

Moreover, it is unclear that humans even avoid reminders of animality. Although proponents of the animal reminder perspective point to disgust toward concepts like sex, bad hygiene, urination, menstruation, and bodily deformity (e.g., Goldenberg et al., 2001; Rozin et al., 2008) as evidence that humans avoid reminders of our animal nature, a lack of disgust (and indeed, a lack of aversion) toward several concepts that would seem to

more straightforwardly act as reminders of animality suggests otherwise. As Royzman and Sabini (2001) point out, people seem to react quite positively – and without disgust – toward several English phrases that draw direct comparisons between humans and animals (e.g., “brave as a lion,” “cool cat,” “foxy lady,” “gentle as a dove,” “strong as an ox,” “wise as an owl”). Further, it is unclear why, if behaviors such as sex and urination are disgusting *because* animals and non-human animals both engage in them, so many other behaviors common to humans and non-human animals do not elicit disgust (e.g., running, breathing, sleeping, vocalizing). Finally, Royzman and Sabini question why, if reminders of creatureliness indeed motivate disgust responses to sex, gore, death, and bad hygiene, then knowledge of the overwhelming overlap in DNA between humans and other primates fail to elicit an intense disgust response. Conflicting anecdotal and logical evidence aside, the processes suggested to have led to the evolution of an animal reminder disgust domain are simply not compatible with modern evolutionary theory (Buss, 1997; Fessler & Navarrete, 2005; Kirkpatrick & Navarrete, 2006; Navarrete, Kurzban, Fessler, & Kirkpatrick, 2004).

Empirical Problems with the Rozin Perspective

This model has also not been well supported empirically. The nine domains suggested by the model were not formed through any vigorous, empirical procedure. Indeed, Haidt et al. (1994) generated these domains by examining 221 disgust elicitors that had been suggested by 20 individuals. The authors did not report any quantitative analyses in generating the domains, nor did they explain a clear, theoretically grounded justification for such categorization; rather, items were simply subjectively categorized along these nine dimensions by the authors. In constructing the Disgust Scale, an

individual differences measure designed to reflect seven of these domains (all but interpersonal contamination and moral) and an additional “magical thinking” domain, the authors found no empirical evidence to support a seven, eight, or nine domain structure of disgust sensitivity. Factor analyses on the 32-item measure did not lead to a conceptually clear rotated solution, and the internal consistencies of each domain purportedly measured in the scale were low (α 's ranging from .34 to .60, with a mean of .48).

Additionally, the measurement properties of the scale were questionable – half of the items asked participants to respond true or false to statement, some of which do not appear to be strongly related to disgust (e.g., “It would go out of my way to avoid walking through a graveyard”; “I think homosexual activities are immoral”), and half of the items asked participants to report their disgust toward different acts on a three-point scale (not at all disgusting, slightly disgusting, extremely disgusting). When items are unit-weighted to compute total scores, these different response formats (0, 1 for true/false; 0, 1, 2 for disgust endorsement) inherently give some items greater weight on the total item score than others, and they bias item variances to be greater in the three-point response items. In sum, the lack of quantitative or theoretical justification for deriving these domains, the lack of empirical support for the existence of, reliable measurement of, and discrimination between these domains, and the questionable psychometric properties of the Disgust Scale render interpretations of past results obtained with the measure ambiguous.

Olatunji et al. (2007) reexamined the model proposed by Haidt et al. (1994) and, via exploratory and confirmatory factor analyses, concluded that the disgust elicitors included in the Disgust Scale actually reflected three domains rather than eight. Based on

theoretical arguments put forth by Rozin et al. (2008), these domains were described as core disgust, animal reminder disgust, and contamination disgust.

Although an empirical improvement on the model suggested by Haidt et al. (1994), this three-domain model still suffers from empirical and theoretical limitations. The labeling of these domains was based on item loadings from a 25-item version of the original 32-item Disgust Scale developed by Haidt et al. (1994), which purportedly measured eight domains. However, the validity of the construct labels and definitions is suspect. Olatunji et al. (2007) define the core disgust domain as responses to “a sense of offensiveness and the threat of contamination,” and the animal reminder domain as “reflect(ing) the aversion of stimuli that reserve as reminders of the animal origins of humans” (p. 282), and they define the contamination domain as “disgust reactions based on the perceived threat of transmission of contagion” (p. 285). The conceptual overlap between the core and contamination domains is obvious; indeed, the word “contamination” is used to label one domain and define another. At first glance, though, it appears that the animal reminder domain may reflect some different aspect of disgust from core disgust. In actuality, reactions to items that are said to elicit core disgust are correlated .88 with reactions to items that are said to elicit animal reminder disgust.

The redundancy in theoretical definitions of these constructs is complemented by overlap in the content of items that are intended to reflect the constructs. For example, items concerning bacterial contamination appear on all three domains. Disgust toward spoiled milk is said to reflect core disgust, disgust toward handling a dead cat is said to reflect animal reminder disgust, and disgust toward accidentally drinking from a glass that someone else has been drinking from is said to reflect contamination disgust.

Moreover, only one of the eight animal reminder items references animals (a dead cat), whereas five of the core disgust items do (monkey meat, a rat, a cockroach, maggots, an earthworm). Further, as was the case with the original Disgust Scale, these domains were proposed based on the loadings of items that do not appear to straightforwardly reflect disgust (e.g., five of the eight items used to define “animal reminder disgust” do not directly address disgust). Hence, the empirical support for distinctions between core, animal reminder, and contamination disgust is based on a) factors that correlate between .65 and .88, b) factors that are measured by potentially disgust irrelevant items, and c) factors that have been defined based on questionable interpretations of factor loadings.

Other Perspectives

Other researchers have suggested that disgust should be categorized along two dimensions: disease-avoidance disgusts, and other disgusts. These are referred to in several ways, including “theoretical” versus “lay” disgusts (Nabi, 2002), “primary” versus “complex” disgusts (Marzillier & Davey, 2004), and “core” versus “socio-moral” disgusts (Simpson, Carter, Anthony, & Overton, 2006). The categorization of multiple, purportedly distinct disgust domains included in models proposed by Haidt et al. (1994), Rozin et al. (2008), and Olatunji et al. (2007) under a single pathogen-avoidance domain is consistent with the high theoretical overlap of domains proposed by Rozin et al. and the high correlations between purportedly distinct domains found by Haidt et al. and Olatunji et al. The distinctiveness between pathogen disgust and complex disgust is also reasonable based on cluster analyses by Marzillier and Davey, differential effects of time on intensity of the two categories (Simpson et al.), differential relations between the two domains and other terms such as “grossed out” and “repulsed” (Nabi), and differential

sensitivities to moral and other disgusts (Haidt et al.; Tybur et al, 2009). Brain imaging studies also point to distinctions between these two types of disgust (Moll et al., 2005; Shaich Borg, Lieberman, & Kiehl 2008; Sambataro et al., 2006).

However, multiple empirical results suggest that such a dichotomy inappropriately lumps sexual disgust – a potential third domain – into one of these two categories. Shaich Borg et al. (2008) directly tested the distinctiveness of disgust toward incest with disgust toward pathogen risks (e.g., scabs) and non-sexual moral violations (e.g., theft) in an fMRI study. Replicating results from Moll et al. (2005) and Sambataro et al. (2006), they found that socio-moral disgust and pathogen disgust activate common “disgust” regions in the brain, but also activate distinct areas that suggest physiological differentiation between the two. But, they also found that disgust toward incest activated a third neural region with both common and distinct activation.

Further, Tybur et al. (2009) performed several factor analyses on self-reported disgust toward a wide array of disgust elicitors. Results consistently demonstrated a three-domain model consisting of pathogen disgust, sexual disgust, and moral disgust. Such results suggest that, while it is appropriate to categorize most core, animal reminder, and interpersonal disgust elicitors described by Rozin et al. (2008) into a single pathogen domain, and that pathogen disgust is distinct from moral disgust, dichotomization omits an important third domain: sexual disgust.

In the next section, I detail how an adaptationist perspective suggests the existence of three domains of disgust, each designed in response to a separate adaptive problem: pathogen disgust, sexual disgust, and moral disgust. Dividing disgust into these three domains is consistent with the empirical results presented by Haidt et al., (1994),

Olatunji et al. (2007), Moll et al., (2005), Sambataro et al. (2006), Shaich Bord et al. (2008), Marzillier and Davey, (2004), Simpson et al. (2006), and Tybur et al. (2009).

Chapter 2

Pathogen Disgust

Individual organisms are constantly threatened by predators of other species; gazelles are threatened by cheetahs, cats are threatened by dogs, and rodents are threatened by raptors. In each of these instances, prey engage in strategies (e.g., escape, concealment) that seem to be motivated by a desire to avoid being killed. Humans can sympathize with other species' plight as prey and their responses. When contemplating organisms that threaten our lives, it's easy to imagine fearsome large carnivores such as bears, crocodiles, and sharks, or of small venomous animals such as spiders and snakes. Indeed, it's likely that animals such as these have been recurrent threats to humans' survival for long periods of time, and the fear that people feel toward them is motivated by psychological adaptation to neutralize the recurrent adaptive problem of predation from recurrent predators (Ohman & Mineka, 2001). When faced with environmental cues for the presence of a potential predator, an emotional system activates and motivates us to neutralize the threat by fleeing from it or hiding.

However, for all the fear that people may feel toward creatures with large teeth or venom, the most threatening organisms to human fitness are microscopic pathogens. Human history is wrought with instances of wide-scale disease epidemics. The Bubonic Plague killed over 200 million people in Europe in the 14th century, a strain of Influenza killed over 50 million people worldwide in 1918, and HIV and Malaria each currently claim millions of lives annually worldwide. Current epidemiologists suggest that SARS, Ebola, or Influenza could have similarly devastating results in today's world (Wilcox & Colwell, 2005). Yet outside of these notable pandemics, pathogens have regularly

infected humans – and non-humans – throughout history, wrecking substantial fitness costs, and even acting as a driving force in the evolution of sexual recombination and other physiological adaptations serving to increase the variability of a host's internal microenvironment (e.g., Tooby, 1982; Maynard-Smith, 1978).

The evolutionary impact of pathogens can be obscured by their sometimes subtle fitness consequences, their small size (and hence direct undetectability via human senses), and, especially, technologies that dampen their impact. Modern first-world society offers many innovations – sanitation, antibiotics, access to hospitalization – that drastically reduce the mortality rate associated with disease. Moreover, in the event of infection, many people can simply “stay home sick” until their illness abates, having easy access to food, temperate shelter, and clean water. These conventions obscure the true costs of infection, both in our own society, those contemporary societies that lack advanced health care, and in the societies in which our ancestors lived. In reality, avoiding infection was one of the most pressing adaptive problems that our ancestors faced (and remains so today). Before the advent of modern health care, humans would have had few, if any, of these conveniences (although foraging societies do provide some health care to the ill, see Sugiyama, 2004), and even something as mild as a head cold could have had important energetic and reproductive costs. Besides generally feeling ill and not being able to optimally hunt or gather resources, an individual with even minor infection would be forced to apply finite energetic resources to combating infection rather than maintaining other biological systems.

Although even minor infections connote energetic costs, more severe infections imply even graver consequences. Consider bejel, a disease endemic to the Middle East

and Africa, as an example. Untreated, bejel severely deteriorates bone, skin, and tissue around the mouth, nose and eyes, and it can result in severe energetic, reproductive, and social costs. Physical deformities caused by the infection can make simple acts like walking, seeing, and eating quite difficult. Moreover, physical deformity associated with the illness presumably greatly impairs one's ability to acquire mates and social allies. Ultimately, the infection could have the same consequences on reproductive output as death. And, of course, death is the ultimate consequence of many infections; indeed, a survey of 3,328 deaths across 13 contemporary hunter-gatherer and horticultural societies found that illness was the cause of death in approximately 70% of cases (Gurven & Kaplan, 2007).

Pathogens have posed such strong fitness consequences that we've evolved an extremely complex and expensive immune system to neutralize infectious microorganisms. Yet for all the attention paid to the function of the physiological immune system, little thought is given to its psychological compliment – a “behavioral immune system” (Schaller, 2006). Given reliable, recurrent cues for pathogen presence, it is inconceivable that selection would have favored the evolution of such a metabolically expensive immune system without also producing psychological adjuncts to motivate behavioral avoidance of infection.

An Emotional Adaptation for Avoiding Pathogens

Humans are not unique in avoiding pathogens – several other species (e.g., mice, bullfrog tadpoles, chimpanzees – see Schaller & Duncan, 2007) demonstrate similar behavioral avoidance of infection risks. In humans, at least, this behavioral avoidance is motivated by an emotional response, which evolved in response to selection pressures to

avoid infection. Although fear functions well in motivating avoidance of large predators or aggressive conspecifics, it would not motivate an efficient response to microorganisms as small as one ten-millionth of our size. In the case of small pathogens that don't give chase at high speeds, rapid flight would not have prevented infection any more than minor proximal avoidance. The behaviors motivated by a fear response – perspiration, increased heart rate, general increased energy use – would have connoted higher energetic costs than a more efficient response to pathogen presence. Selection would thus have favored a more efficient behavioral strategy motivated by a separate emotional response: pathogen disgust. Rather than motivating rapid flight from a threatening large organism, pathogen disgust motivates comparatively minor proximal avoidance of objects deemed to be disease threats.

Although pathogens themselves are indeed often invisible to the naked eye, we do have the ability to detect their presence with some accuracy. Given their microscopic nature, the best evolution could do is to take advantage of olfactory, visual, tactile, and auditory *cues* that correlated with pathogen presence to shape an “intuitive microbiology” (Pinker, 1998). Selection favored an emotional response – pathogen disgust – that motivated avoidance of objects possessing the cues associated with anything that reliably housed pathogens. Common pathogen-housing objects and substances include feces, vomit, spoiled food, blood, saliva, semen, ticks, fleas, lice, snails, slugs, flies, and worms (Curtis & Biran, 2001). And it should not be surprising that each of these is regularly described as “disgusting.” However, humans do not have omniscient knowledge of the true pathogen threats posed by such objects. Rather, we must rely on visual, olfactory, tactile, and auditory cues to determine if something in the environment likely belongs in

one of these categories. Thus, instead of evolving to find feces, blood, or semen disgusting per se, we've evolved to judge things that smell like feces, look like blood, or feel like goop to be disgusting. Liquids that are yellow, brown, and red – colors of potentially infectious bodily secretions such as pus, blood, and semen – are judged to be more disgusting than those that are blue; faces that are altered to appear wet and splotchy – states that are associated with fever – are rated as more disgusting than “normal” faces; and skin lesions that are open and oozing – states that connote wound infection – are rated as more disgusting than dry, unbroken lesions characteristic of burns (Curtis et al., 2004).

The evolution of a system designed to detect pathogen presence with some degree of accuracy was a tremendous advantage for individuals in their continuous conflict with infectious microorganisms. By acquiring infections at a lower frequency, the metabolic resources that would otherwise be applied to fighting parasites could instead be used for tasks related to foraging, attracting mates, investing in kin and other social allies, and maintaining other somatic systems. Moreover, avoiding infectious agents would drastically reduce the risk of disease-related morbidity and mortality.

How to Get an Infection

In conjunction with the immune system and pathogen disgust, humans combat pathogens with the skin, which acts as a layer of microbe repelling armor. If our senses fail to detect pathogens – or if we fail to successfully avoid them – infection is not inevitable. Most pathogens must first bypass the skin and enter the body before they wreck havoc. They can do this either through a puncture wound that opens up a path directly into the body, or via one of the body's naturally occurring “gateways” (the eyes,

ears, nostrils, mouth, urethra, vagina, and anus) to the outside world. If the human body is pictured as a castle fortified in a manner that keeps pathogens at bay, bodily orifices are the vulnerable entrances through which pathogens can bypass exterior security.

Requirements to collect nutritional and sensory information from the outside world – and to eject bodily wastes – necessitate that we constantly risk being compromised by pathogens through these routes. Not coincidentally, we are extremely averse to allowing most objects to come into contact with any bodily orifice (Fessler & Haley, 2006; Rozin, Nemeroff, Horowitz, Gordon, & Voet 1995), and the degree of aversion people feel toward being “penetrated” is related to the degree to which they feel vulnerable to infection (Tybur, 2005).

Given our requirement for nourishment and our vulnerability to disease, it’s not surprising that people view eating with some ambivalence, as any meal can be a pathogenic Trojan Horse. Any meat (or other animal product) potentially houses harmful amounts of bacteria (e.g., *Salmonella*, *E. Coli*) or macro-parasites (e.g., tapeworms). Although vegetable matter also has the potential to house pathogenic bacteria and fungus, meats contain pathogens at a much higher intensity and rate. Any time a food source comes into contact with a “polluted” (infected) object, it has the potential to acquire infectious pathogens, thus making it an infection risk (e.g., a formerly clean piece of meat that is covered in flies may now house pathogens that the fly carried on it from its last meal of feces or rotting meat). Regardless of the differential infection risks of eating (i.e., it’s more likely for a human to acquire an infection when eating cow than when eating grass), any meal has the potential to cause great harm, and net nutritional benefits must be weighed against perceived infection risk.

Many disgusting objects are perceived as such because they possess cues (e.g., the smell associated with feces) that have reliably been associated with pathogens over long periods of evolutionary time. A system designed to find only the prospect of eating objects that exhibit these cues would be devastatingly inefficient, and likely never would have evolved. For example, if we only found it disgusting to *eat* feces, but we didn't mind handling the substance, the bacteria housed inside would make its way from our hands into our eyes, our genitals, puncture wounds or scrapes we might acquire, and, perhaps most importantly, onto our "clean" food and into our mouths. Rozin and Fallon's (1987) core disgust is thus not best characterized as related to food specifically, but as related to pathogens, which often enter the body via the mouth.

Several evolutionarily oriented scholars have similarly suggested that disgust evolved to motivate pathogen avoidance (e.g., Curtis et al, 2004; Curtis & Biran, 2001; Kurzban & Leary, 2001; Pinker, 1997; Haidt, et al., 1997), and Curtis and Biran (2001) illustrate the myriad of legitimate disease threats posed by "disgusting" smells and sights. However, these arguments can intuitively appear shortsighted and insufficient in light of the ease with which pathogenic disgust elicitors can lose their infectiousness without losing their capacity to disgust. Rozin et al. (1986) illustrated the inconsistency between infection risk and disgust by "sterilizing" dead cockroaches, dog feces, and vomit (the cockroach was literally sterilized while the dog feces was in reality fudge and the vomit was a rubber imitation of vomit) and observing that people show strong aversion to contact with the items possessing cues for infection even though they rationally know that no infection risk is present. It's quite easy to generate examples of disgusting stimuli that don't pose an infection risk; indeed, one could think of somehow sterilizing virtually

anything that's both disgusting and infectious, and results would probably be identical to Rozin et al.'s. This phenomenon has led several researchers to conclude that disgust functions in a generally abstract, self-protection manner rather than a specific, disease-avoidance manner. However, an evolutionarily informed perspective easily accounts for disgust toward rationally noninfectious objects.

Adaptive Bias in Pathogen Disgust

The first explanation is related to an application of signal detection theory (Green & Swets, 1966). "The smoke detector principle" (Nesse, 2005; Nesse, 2001) generally suggests that asymmetries associated with the costs of failing to identify potential threats and "false alarming" to nonexistent threats will promote bias toward the less costly error (e.g., having a fever when parasites pose a mild threat rather than not having a fever when parasites pose a grave threat). Similarly, Error Management Theory (Haselton & Nettle, 2006; Haselton & Buss, 2000) argues that, because humans have rarely had perfect knowledge of the world over our evolutionary history, we have evolved adaptive biases that promote committing the less costly of two cognitive errors under ambiguous conditions.

Adaptive bias can account for much of the disgust expressed toward entities that pose objectively low (or, in some cases, nonexistent) infection threats. Vomit is a good example. People encounter vomit regularly (and they probably have throughout our evolutionary history), and they tend to be quite disgusted by it. This disgust motivates behavioral avoidance that in turn decreases the potential for the vomit to come into contact with the body's interior. But even though people tend to avoid vomit like the plague, the probability of actually *contracting* the plague (or another infectious disease)

from contacting the vomit is unknown. This probability is influenced by several factors, including the vomiter's current health status (e.g., did he vomit from motion sickness or did he vomit because he had a bacterial infection), the observer's current immune strength, and the probability that the microbes in the vomit could enter the observer's body, etc. Because it's impossible to calculate the exact infection risk posed by the vomit, selection has favored adaptive bias toward being hypersensitive and making false alarms (i.e., acting as if the vomit poses a serious infection risk) rather missing a potential infection risk. Both errors have costs, but the costs associated with a false alarm (i.e., feeling an emotion that motivates avoidance of the area in which the vomit rests when the vomit doesn't pose a serious infection risk) are much lower than the cost associated with a miss (i.e., not avoiding an area that poses an infection risk and contracting a serious illness). Indeed, people seem prone to *always* treating vomit as an infection risk, and they pay the usually minor cost of enthusiastically avoiding a small area.

Most disgust-evoking stimuli follow this principle. Among other things, feces can transmit hepatitis A and cholera, blood can transmit lassa fever and syphilis, skin lesions can transmit chicken pox and staph infections, and nasal secretions can transmit rubella and tuberculosis (Curtis & Biran, 2001). Each of these disgust elicitors *can* transmit these infections (and many others), but the probability of any one encounter with these substances causing substantial fitness impairment is uncertain. Still, despite a potentially low probability of contracting a harmful infection from one of these substances, the correct strategy in a world of uncertainty is to pay the relatively low costs of avoidance rather than paying the severe (albeit perhaps infrequent) costs of potentially fatal infection.

The power of this adaptive bias is relevant not only to our reactions to everyday disgust elicitors that pose little realistic infection risk, but to irrational disgust responses to stimuli that pose *no* infection risk. For example, people appear to avoid others who possess physical handicaps (e.g., missing limbs, confinement to wheelchairs) in a manner that shows evidence for design to avoid pathogens (Park, et al., 2003). Although these individuals may be physically handicapped because of something environmentally mediated (e.g., a car accident), people treat them as if they carry an infectious disease. The costs of subtly stigmatizing and avoiding close contact with people possessing bodily abnormalities – most of which probably *were* caused by infectious disease (e.g., bejel, elephantitis caused by filariasis) over our evolutionary history – was again quite low compared to the costs of *not* avoiding them and potentially catching a debilitating disease.

Mismatches

Modern life presents several contingencies that “mismatch” with the environment in which we evolved. Sexual behavior in light of contraception is a prototypical example. Although sexual desire and sexual pleasure evolved because they motivated behavior that resulted in conception, they persist today even in people who intentionally avoid pregnancy through the use of contraceptives. Because contraception was not a part of the environment in which we evolved (i.e., it “mismatches” with the current environment), we respond to sexual stimulation as if it was the ultimate manner for reproduction regardless of our rational knowledge that it will not result in conception if we use contraceptives. Other mismatches include our preferences for fatty, salty, and sweetened

foods, and our emotional responses to rationally benign images shown on two-dimensional surfaces (Maner et al., 2004; Gross & Levenson, 1995).

Artificially sterile objects also “mismatch” with the environment in which we evolved. Simply telling someone that a cockroach – or any object that possesses cues for infection risk – has been sterilized likely does not remove the appraisal of infection risk. This disgust is irrational in the same way that being frightened by a scary book or aroused by an erotic film is irrational, but it is nevertheless motivated by psychological adaptation for avoiding infection.

Several aspects of our modern environment render the formerly infectious relatively safe. One could avoid acquiring a sexually transmitted disease by using a condom during sexual intercourse. One could puncture the skin with a sterilized needle and immediately apply an antimicrobial substance and a bandage to the wound. One could even safely handle vomit or feces by wearing rubber gloves. Each of these acts involves modern technologies that allow for avoidance of infection under circumstances that would have otherwise been extremely dangerous over most of our evolutionary history. Because selection has not had sufficient time to attenuate the pathogen-avoidance psychology involved in several acts rendered safe by modern technologies, we often react to non-infectious stimuli with an “irrational” disease-avoidance response.

Confusion Regarding Pathogen Disgust

Because of issues related to evolutionary mismatch, adaptive bias, and perhaps an overemphasis on food, Rozin et al. (2000) suggest the presence of multiple disgust domains that I believe should be described as pathogen disgust. For example, they suggest a death disgust domain motivated by “a universal fear of death”. This

interpretation of disgust toward decay and rot is highly questionable, since being disgusted by a dead animal does little to motivate behavior that would solve the adaptive problem of dying, or the purported problem of being afraid of death. Moreover, a pathogen disgust interpretation is much more parsimonious than a fear-of-death explanation. When an organism dies, its body is immediately overcome with potentially infectious bacteria, and contact with the dead can easily transmit those bacteria from the corpse into your body.

This pathogen disgust framework sheds light onto why several concepts elicit disgust. For example, disgust toward certain human bodily abnormalities, potentially including amputated limbs, obesity, cleft palates, and large pigmented birthmarks, may exist because of adaptive bias in judgment; the costs associated with being overly sensitive to bodily abnormalities and avoiding them even when they don't connote infection risk were greater than the costs associated with being insensitive to bodily abnormalities and risking infection risk (examples of bodily abnormalities that do connote potential infection risk include elephantitis caused by Filial worms, disfigurement caused by Leprosy, and lesions associated with Bejel). Several studies have confirmed this hypothesis, finding that individuals with seemingly noninfectious bodily abnormalities are associated with disease (Park, Schaller, & Crandall, 2007; Park et al., 2003; Duncan & Schaller, 2005).

Pathogen disgust doesn't seem quite as unruly in light of the strong fitness costs our ancestors paid in the event of infection. Although a minor respiratory infection or stomach ailment seem relatively innocuous now, they nevertheless are energetically costly to combat, and they were a significant handicap in the absence of plentiful food,

water, and shelter. And although more serious infections are often rendered mere annoyances by antibiotics and vaccines, they extracted massive fitness costs from our ancestors, and they would in us now in the absence of modern medicine. Biases in judgment are thus skewed toward being hyper-sensitive to potential infection risk, and the novelties of sterilization and artificial barriers against infection do little to deflate the disgust we feel toward stimuli that are estimated to carry even a minor infection risk.

Chapter 3

Sexual Disgust

Multiple researchers (e.g., Angyal, 1941; Miller, 1997; Rozin et al., 2000; Thompkins, 1963) have recognized a connection between sexuality and disgust. The Rozin perspective suggests that the connection falls under the animal reminder disgust domain – humans are disgusted by sexuality to reject a potential reminder that we are animals and will eventually die. As previously noted, the plausibility of the animal reminder perspective is highly suspect. Moreover, this perspective ignores the strong adaptive consequences of sexual choices and behaviors, and the potential utility of an emotion such as disgust in the realm of sexual decision-making.

The Importance of Mating

Across species, animals' mating decisions are profoundly important. Certain sexual partners can produce healthy offspring who in turn produce healthy offspring; others can produce no offspring or unhealthy offspring who may not reproduce themselves. Selection has thus favored the evolution of psychologies that can judge a potential mate's quality, and emotions that motivate pursuit when appropriate. Consequently, a bevy of research has indicated that traits associated with genetic quality (e.g., health and fertility) are perceived as sexually attractive (for a review, see Grammer, Fink, Moller, & Thornhill, 2003).

Genetic quality can be categorized as intrinsic quality and compatibility (Zeh & Zeh, 1996; Jenions & Petrie, 2000). Intrinsically good genes additively contribute to offspring quality. For example, low mutation load, especially at key loci involved in the expression of traits found to be sexually attraction (Rowe & Houle, 1996) makes genes

intrinsically “good.” Compatible genes, on the other hand, interact with a sexual partner’s genes; they can be detrimental or beneficial in offspring depending on how they match with a sexual partner’s. For example, it has been suggested that a certain level of dissimilarity between parents on immune-relevant Major Histocompatibility Complex (MHC) alleles lead to optimal immune function in offspring (Penn & Potts, 1999), and humans prefer the scent of MHC dissimilarity (Thornhill, Gangestad, Miller, Scheyd, McCollough, & Franklin, 2003; Wedekind & Furi, 1997) and tend to marry others who are MHC dissimilar (Ober, Weitkamp, Cox, Dytch, Kostyu, & Elias, 1997). Possessing a certain combination of MHC alleles does not necessarily intrinsically lead to healthy or unhealthy offspring. Rather, the quality of the alleles depends on whom one is sharing them with.

Although the reproductive benefits of mating can be high – as are the costs associated with missing a mating opportunity (Haselton & Buss, 2000) – mating involves several non-trivial costs, including:

- 1) Opportunity Costs: Every investment of time and energy into pursuing or copulating with a mate entails a sacrifice of resource investment in something else (e.g., investing in non-romantic relationships with kin or social allies, gathering resources). More specifically, investment in pursuing one mate sacrifices the opportunity to pursue another, who may be a better option. This cost is especially high for women. When choosing to copulate, a woman essentially risks sacrificing the opportunity to conceive with any other man for at least nine months. If the man she conceives with is particularly low quality (e.g., has a high mutation load; has very incompatible genes), she would not only produce a

relatively poor quality offspring; she also would lose the opportunity to produce a high quality offspring with another man during that time.

- 2) Energetic and Birthing Costs: Pregnancy is metabolically expensive for women, and, although necessary for reproduction, can be deadly under certain conditions. Further, a woman risks death with each birth, with per-birth mortality rates varying between approximately 2% in modern developing nations and 0.001% in modern developed nations (Van Lerberghe & De Brouwere, 2001). Death can be viewed as the ultimate opportunity cost in this sense, as each conception has the potential to be a woman's last because of death during birth.
- 3) Disease: Sexual behaviors, including hugging, kissing, oral sex, anal sex, and intercourse are among the most disease-risky activities that humans engage in. A simple hug can transmit any pathogens resting on the flesh from one to another. A closed-mouth kiss adds the potential of transmitting any pathogens transmitted through respiratory fluids, and an open mouthed kiss allows transmission of pathogens living in saliva. Oral sex further increases the risk of contracting disease carried in semen or vaginal fluids. Sexual intercourse causes small tears in the vagina and on the penis, and these tears allow routes through which pathogens can be transmitted.

The costs and benefits of mating vary as a function of several variables, and people simultaneously seek out certain individuals as mates while avoiding others. Given the ubiquity of these mating costs across species, it shouldn't be surprising that sexual avoidance is not unique to humans. Indeed, even chimpanzee females, who are characterized as highly promiscuous and largely under the sexual control of males,

strategically (and somewhat successfully) avoid copulating with males who are deemed unacceptable mates (Stumpf & Boesch, 2005). For humans, at least, approach and avoidance of potential sexual partners is motivated by emotional responses. Given that disgust has been described as a reaction to unwanted sexual contact (Tomkins, 1963) and as the antithesis of sexual arousal (Koukounas & McCabe, 1997; Vonderheide & Mosher, 1988), it seems reasonable to describe the motivation to avoid sexual contact as disgust, and the motivation to seek out sexual contact as lust.

The function and necessity of a lust response is straightforward: when an individual detects someone who demonstrates cues associated with high mate quality, they may feel an intense desire to engage in various behaviors that reliably lead to conception. But the simple absence of a lust response is no more adequate for avoiding mating with inappropriate sexual partners than the absence of gustatory desire is adequate for avoiding the pathogens housed within feces. Just as apathy toward feces may not sufficiently prevent one from handling or accidentally ingesting them, simply lacking an intense desire to mate with a low-quality partner (i.e., being apathetic) may not effectively prevent copulation. Because the costs to mating – especially with a low-quality partner – are so great, an emotion that motivates people to avoid and reject costly mating opportunities that offer few benefits is necessary. This emotion is what I call sexual disgust.

Hypothetically, selection co-opted pathogen disgust for the function of avoiding costly mating activities. Both avoiding pathogens and avoiding costly mating require a specific emotional response consistent with disgust. Avoidance motivated by fear, which may involve flight or concealment, would be an inefficient and potentially ineffective

way of avoiding sub-optimal sexual behaviors. Because costly sexual partners may actually be excellent social partners in other contexts (e.g., a trustworthy and reciprocating, but sexually unattractive, friend), a motivation to flee that person when sexual behavior is considered may damage other benefits gleaned from the relationship. However, being disgusted by the prospect of a specifically sexual relationship with that person may motivate avoidance of pursuing a sexual relationship, or to specifically reject potential sexual advances.

Differentiating Sexual and Pathogen Disgust

From a certain perspective, sexual disgust is nothing more than pathogen disgust (this idea was alluded to by Angyal, 1941). Because sexual intercourse involves close interpersonal contact and exchange of bodily fluids, it is inherently a strong disease risk (indeed, many diseases transmitted between humans can be thought of as transmissible through intimate interactions like sex). Through some unknown mechanism, pathogen disgust is suppressed when considering sexual behavior with another individual who is deemed high quality.

Although the two disgusts are related, they are distinguishable for two primary reasons. First, the two motivate different behavioral responses. Pathogen disgust motivates proximal distance from an infected individual (or disease-risky act), whereas sexual disgust specifically motivates avoidance of sexual relationships even if disease-risky acts (e.g., intercourse) have yet to be initiated; this avoidance of sexual behavior can be unrelated to proximity. Second, they are elicited by vastly different cues. Whereas pathogen disgust is elicited by cues that have indicated pathogen presence over

evolutionary history, sexual disgust is elicited by cues for kinship or cues for poor quality or poor compatibility.

Cues for poor intrinsic quality

Conceivably, many of the same cues used to detect high quality are also used to detect low quality. For example, if high facial symmetry indicates high quality via immunocompetence (as found by Thornhill & Gangestad, 2006), low facial symmetry indicates low quality via susceptibility to infection. Notably, many traits (e.g., facial masculinity and symmetry) used to assess attractiveness are more strongly associated with underlying quality on the negative end of distribution of attractiveness ratings (Zebrowitz & Rhodes, 2004). Thus, when assessing a potential mate's quality, it's sometimes only the notably unattractive individuals who reliably exhibit cues of low quality, and who should especially be avoided as sexual partners. These cues – many of which are associated with disorders such as Canavan disease, Down syndrome, Late Onset Tay-Sachs disease, and XYY syndrome – include impaired cognitive function, unusual facial structure, unusually poor muscle tone, poor motor control, obesity or gauntness, and abnormally long or short limbs. Additionally, displays of personality, creativity, and moral virtues may signal quality, or lack thereof (Haselton & Miller, 2005; Miller, 2000, 2007).

Adaptive bias in judgment and mismatches operates in sexual disgust as in pathogen disgust. Environmental insults (e.g., a blow to the face, being hit by a car, having severe burns) may lead to facial deformity or neurological impairment. The cues for poor intrinsic quality may exist, but the victim's genes may be just fine. Because such deviations from a “normal” appearance have reliably connoted inheritable mutation over

our evolutionary history, and because the costs of “missing” cues for poor intrinsic quality are much lower than the costs of failing to detect them, such environmental insults are unconsciously perceived as connoting some genetic affliction.

Olfactory cues also indicate intrinsic gene quality, and they may play a role in motivating sexual disgust. Fluctuating asymmetry (FA, i.e., the degree to which a person’s body departs from being bilaterally symmetric) has been shown to correlate with several variables related to survival and reproduction (reviews in Gangestad & Thornhill, 1999; Moller & Swaddle, 1997). Numerous studies (e.g., Gangestad & Thornhill, 1998; Rikowski & Grammer, 1999; Thornhill et al., 2003) have indicated that women in the fertile phase of their menstrual cycles – the time in which they could conceive if they engaged in intercourse – are sensitive to the scent of symmetry, even when they do not have any other information about the person’s identity.

Cues for Poor Compatibility

Close genetic relatedness is an important form of poor genetic compatibility. Humans possess multiple recessive, potentially lethal deleterious alleles (Bittles & Neel, 1994). These genes are usually not problematic, because they lie unexpressed in their heterozygous form. And because of their infrequency, it’s extremely unlikely that two parents would both have a specific recessive allele and both pass that gene on to an offspring. However, when sexual partners are close genetic relatives, the probability that they share a specific lethal recessive gene increases considerably. Thus an individual of the opposite sex who demonstrates high intrinsic quality (e.g., low FA, optimal waist-to-hip ratio, attractive skin) could be an extremely poor reproductive partner if they share lethal recessive alleles.

Given these costs, it's not surprising that incest is universally avoided and even tabooed across human cultures (Brown, 1991). But as is the case with intrinsic quality, it's impossible to have exact knowledge of one's degree of relatedness to a potential sexual partner. Humans must thus rely on cues for kinship.

Drawing on adaptationist logic and work by Wolf (1995) and Shepher (1971), Lieberman, Tooby, and Cosmides (2003) suggested that a system designed to estimate kinship between siblings would optimally function by measuring co-residence duration during childhood. They predicted that individuals who cohabitated with an opposite-sex sibling during childhood would have received cues indicating close relatedness to a member of the opposite sex, and thus would develop a strong aversion to sibling-incest. More specifically, they predicted that the *length* of co-residence with an opposite sex sibling would predict incest-aversion. Consistent with this hypothesis, they found that an individual's length of co-residence with a sibling predicted the degree to which sibling incest was judged to be morally wrong. Moreover, they found that, once length of co-residence was accounted for, there was no relationship between incest-aversion and objective degree of relatedness between an individual and an opposite-sex sibling (i.e., controlling for co-residence duration, those who had opposite-sex siblings showed no greater incest aversion than those who had half-siblings or step-siblings). Finally, they also demonstrated that length of co-residence with an opposite-sex sibling predicted incest aversion strongly even when those siblings were not related (i.e., they were step-siblings or adopted).

This last finding – that co-residence duration is related to incest avoidance even when there is no objective risk of sibling incest – demonstrates that cues for a mate's

quality and compatibility are imperfect, just as cues for infectious disease and intrinsic quality are. As Wolf (1995) and Shepher (1971) both demonstrated, unrelated individuals can respond toward each other as if they are extremely genetically incompatible simply because they were raised together, even if they are socially encouraged to mate.

Disgust Toward Specific Sexual Acts

As previously noted, intimate sexual contact is extremely disease-risky, and pathogen disgust must be “suppressed” in order for the prospect of intimately sharing bodily fluids with another individual to be appealing rather than aversive. Pathogen disgust is not suppressed in a general manner when one identifies a desirable sexual partner, though. Rather, disgust toward very specific activities (e.g., close physical contact, genital contact with seminal and vaginal fluids) that are necessary for reproduction is suppressed. Disgust toward other pathogen risks that are not associated with reproduction (e.g., oral contact with nasal fluids) is not suppressed.

The degree to which depression in pathogen disgust is generalized to non-intercourse activities appears to vary substantially both within (Tybur et al., 2009) and between societies (Ford & Beach, 1951). At this point, the mechanism through which this variation occurs is unclear. Conceivably, local pathogen presence may influence generalization of sexuality beyond intercourse. In pathogen-rich ecologies, the costs of overgeneralization are likely higher than those in lower prevalence locales. Schaller and Murray (2008) found support for this hypothesis: cross-cultural variation in sociosexuality – which is conceivably negatively correlated with sexual disgust – is associated with parasite prevalence; those cultures with fewer parasites are more open to casual sexual activities. Additionally, something as simple as hygiene availability may

influence the generalization of pathogen disgust suppression, both within and between societies. Groups that bathe with high frequency may remove residual body odors that would otherwise trigger pathogen disgust, thus allowing evolutionarily novel sexual activities (e.g., oral sex). Of course, greater access to hygiene is related to pathogen prevalence, but personal hygiene may reduce cues for pathogen prevalence that do not indicate a true infection risk.

In exploring individual differences in sensitivity to disgust (i.e., the degree to which people report feeling disgust toward various concepts), Tybur et al. (2009) found that items concerning sexual acts (e.g., performing oral sex; having anal sex) and partner choice (e.g., bringing someone you just met back to your room to have sex; finding out someone you don't like has sexual fantasies about you) consistently loaded on the same "sexual disgust" factor across multiple studies. This may suggest that disgust toward low-quality partners and disgust toward specific sexual acts may be subsumed within a common sexual disgust domain.

Chapter 4

Moral Disgust

When asked to generate a general list of disgusting concepts, people often report moral violations along with concepts that would be categorized as Pathogen Disgust or Sexual Disgust (Haidt et al., 1994; Nabi, 2002). These moral violations broadly include concepts related to norm violating anti-social activities such as lying, cheating, and stealing. It would seem that the word “disgust” is often colloquially used to refer to something different from what we have described as pathogen disgust and sexual disgust. In this vein, Nabi (2002) argued that it’s important to examine the “theoretical versus the lay meaning of disgust,” (pp.1). This statement is half-correct. It is indeed important to recognize the domain specificity of disgust. However, pitting the “lay” meaning of disgust versus the “theoretical” meaning of disgust incorrectly implies that one have theoretical primacy over the other – that one is an abstraction of language, and the other should be of interest to social scientists.

Is Moral Disgust Really Disgust?

Multiple pieces of evidence suggest that moral disgust is indeed a phenomenon worth studying, and is not merely a colloquial abstraction of language. In a study of the relationship between disgust and morality across cultures, Haidt et al. (1997) found that all languages surveyed use the same word to describe moral violations and infectious entities like feces and cockroaches, suggesting that the existence of moral “disgust” is not simply a quirk of the English language, but is a reliable cross-cultural phenomenon. Jones and Fitness (2008) found that Australian psychology students who read vignettes about crimes involving drug trafficking, conning, fraud, or theft were more likely to form words

associated with pathogen disgust in a word-stem completion task relative to controls. Wheatley and Haidt (2005) demonstrated that participants hypnotized to feel disgust toward arbitrary words had more severe moral judgments of morally questionable individuals, Schnall, Haidt, Clore, and Jordan (2008) found that disgusting odors and videos increased the severity of moral judgments relative to controls, and Schnall, Benton, and Harvey (2008) found that individuals primed with “cleanliness” (either through washing their hands or being exposed to semantic primes) judged moral offenses less severely than controls. Chapman, Kim, Susskind, and Anderson (2009) found that the same facial muscles are engaged when participants were exposed to photos of contaminants relative to unfair treatment in an economics game. Even children as young as six years old describe immoral behaviors with the word disgust, and photographs of disgust facial expressions to verbal descriptions of immoral activities (Danovitch & Bloom, 2009). Finally, multiple fMRI studies have shown overlap in the neural regions activated during moral judgment versus pathogen disgust (Moll et al., 2005; Schaich Borg et al., 2008).

Despite these findings, though, moral disgust is often intuitively viewed as an abstraction, or an illegitimate emotion. Perhaps pathogen disgust is viewed as “real” and moral disgust is viewed as a metaphor or abstraction because pathogen cues typically elicit only disgust, whereas moral violations can elicit a suite of emotions (e.g., anger, guilt, contempt, disgust, sadness). Regardless of the reason for its neglect, moral disgust appears to be a legitimate emotion related to the previously discussed disgust domains.

Why Be Disgusted by Moral Transgressions?

Humans evolved in close-knit groups in which interdependence and social exchange were the norm. Frequent social interactions and exchanges connoted large benefits to individuals within groups, but they also afforded the potential for substantial costs. Individuals who violate social norms in domains related to reciprocity impose high costs on other group members by reaping benefits associated with group living without paying the involved costs. By violating a norm (e.g., by stealing), individuals impose costs to other group members either directly, by interacting with a specific person in a costly manner (e.g., stealing something from them or lying to them), or indirectly, by disrupting the nature of the group's social contract (Cottrell & Neuberg, 2005). These indirect costs may range from decreased group reciprocity norms due to the potential costs of non-reciprocity to a greater potential for direct costs from an at-large norm violator. Thus, for the benefits of group living to exceed the potential costs of social-contract violators, a system under which social parasites are punished must develop (Cosmides & Tooby, 1989, 1992).

And indeed, humans do engage in third-party punishment. Even when not directly affected by a norm violation, people will sacrifice their own money in experimental economics games to punish norm violators (Fehr & Fishbacher, 2004; Fehr & Gächter, 2002; Kurzban, DeScioli, & O'Brien, 2007), and they will endorse similar monetary fines as punishments (Lieberman & Link, 2007). It is possible that moral disgust motivates such third-party punishments.

Second- and third-party punishments connote different benefits but similar costs, and thus require different behavioral actions. Second-party punishment (i.e., punishment

enacted by the individual who has been directly victimized) may have evolved as a means of recouping stolen resources, or as a method of discouraging further abuses in subsequent interactions (Kurzban, et al., 2007). Third-party punishment, on the other hand, may have evolved as a costly signal of quality (Gintis, Smith, & Bowles, 2001), as advertisement for knowledge and endorsement of social norms (and thus viability as a social partner, Barclay, 2006), or as preventative action in the event that the norm violator may impose direct costs in the future. The benefits of punishing may vary considerably depending on second-party or third-party context. By punishing a norm violator imposing direct costs, one may recoup resources may discourage future violations. By punishing a norm violator imposing indirect costs, one may gain reputational benefits or avoid future costly interactions with a poor social partner. The latter benefits will usually be lower than the former.

However, the gross costs of punishing should not vary considerably across third and second party contexts. Directly aggressive confrontation, such as physical violence or verbal aggression, may put an individual at risk for violent retribution. Because the benefits of third-party punishment are lower than those of second-party punishment, identical behavioral strategies may be inappropriate for the two categories. Whereas direct aggressiveness may be a superior strategy for dealing with behaviors resulting in direct costs, indirect aggression and social exclusion may be better options for dealing with behaviors imposing indirect costs.

Anger motivates direct confrontation (Cottrell & Neuberg, 2005), and it is associated with social punishment (Kurzban, et al., 2007). However, because behaviors motivated by anger (e.g., direct aggression) can carry high costs, mostly related to

physical retribution (Campbell, 2005), behaviors associated with third-party punishment may be motivated by another emotion. This emotion would motivate punitive behaviors, including social exclusion and indirect aggression. This emotion is what is commonly referred to as moral disgust.

The Evolution of Moral Disgust

Pathogen disgust motivates social avoidance and stigmatization of infected conspecifics (Kurzban & Leary, 2001), and selection may have co-opted pathogen and/or sexual disgust for the purpose of motivating punitive behaviors when the potential costs of direct aggression (motivated by anger) are inappropriate for the potential benefits acquired from punishing. One form of punishment may be social avoidance, wherein an individual is excluded from gaining the benefits associated with intragroup reciprocity. The general proximal avoidance of infected others motivated by pathogen disgust, or the avoidance of specific (sexual) acts with poor quality mates motivated by sexual disgust, are somewhat similar to the social avoidance that may be motivated by moral disgust.

It's been suggested that moral disgust functions to motivate avoidance of a moral violator, and that this avoidance not only removes one from a moral "threat" but also punishes and ostracizes the offender (Curtis, 2001). The moral avoidance hypothesis suggests that moral disgust motivates proximal avoidance just as pathogen disgust does. Avoidance, however, is not the ultimate behavioral function of moral disgust, but one of many behavioral strategies that may result in its ultimate function, which is social punishment. Unlike interaction with individuals who are pathogenically infectious, proximity to an anti-social individual carries no explicit costs. Conceivably, interacting in a friendly manner in close proximity with someone who is a renowned cheater may result

in some stigma by association, but it is the manner of interaction – not the proximity – that may carry this cost. One could just as easily engage in some form of punishment (e.g., displaying sneering disapproval) toward the same individual from the same distance, completely changing the costs and benefits of the interaction.

Moral Disgust: Is it Really Moral?

Referring to this type of disgust as “moral” is problematic for a few reasons. First, it suggests that an act or idea is disgusting because it violates morality. As Haidt (2001) argues, moral judgment is likely not a rational deductive process. Instead, it’s the attribution of seemingly irrational affect caused by unrecognized motivations. Although the disgust someone feels toward another person whom they see stealing from a child may be motivated by psychological adaptation for punishing anti-social group members, the person feeling disgust doesn’t necessarily recognize the emotion’s ultimate causation. They observe the transgression, intuitively feel some form of disgust toward the violator, and explain their reaction as related to “morality,” a vague concept that doesn’t sufficiently describe the motivation behind their reaction.

Second, it incorrectly implies that the disgust’s function is related to morality. However, regulating morality is not an adaptive problem. Just as I refer to one domain of disgust as pathogen disgust because it motivates pathogen avoidance and another domain as sexual disgust because it motivates sexual avoidance, it would perhaps be more appropriate to refer to the moral kind of disgust as “anti-social disgust” or “norm violation disgust” because it motivates punishment of behaviors and ideas deemed detrimental to group functioning.

Third, it threatens to confuse the different disgust domains. Any disgust reaction can be labeled as moral (e.g., pathogen disgust toward someone who picks their nose; sexual disgust toward the thought of having sex with a stranger) if it is attributed to morality. This can potentially create artificial overlap between qualitatively distinct domains of pathogen, sexual, and anti-social disgust. However, because of the frequency with which the term “moral disgust” is used to describe anti-social norm violator disgust, it seems most simple to maintain the label moral disgust.

Chapter 5

Individual Differences Across Domains

Disgust sensitivity – the intensity with which individuals feel disgust toward a variety of disgust elicitors – is a popular personality construct in psychology. To date, the Disgust Scale (DS; Haidt et al., 1994), a self-report measure of disgust sensitivity, has been used in over 100 published articles spanning diverse areas of research, including studies of social stigma (Smith, Loewenstein, Rozin, Sherriff, & Ubel, 2007), phobias (Olatunji, Williams, Sawchuk, & Lohr, 2006), obsessive compulsive disorder (Berle & Philips, 2006; Woody & Tolin, 2002), gender roles (Charash, McCay, & Dipaolo, 2006), ethnocentrism (Navarrete & Fessler, 2006), attitudes toward body image and the self (Fessler & Haley, 2006; Burris & Rempel, 2004), religiosity (Olatunji, Tolin, Huppert, & Lohr 2005), homophobia (Olatunji, in press), and eating disorders (Troop, Murphy, Bramon, & Treasure, 2000; Troop, Treasure, & Serpell, 2002). Most studies investigating how disgust sensitivity relates to other variables have used the DS and almost exclusively used the theoretical framework espoused by Rozin et al. (2008), interpreting results in the context of a purported animal reminder function of disgust.

Using the alternative theoretical framework discussed in this manuscript, Tybur et al. (2009) reexamined individual differences in sensitivity to disgust. The authors started by conducting an exploratory factor analysis (EFA) on 160 individuals' disgust ratings of 48 items. This analysis suggested a three-factor structure of disgust sensitivity, and item loadings suggested that these factors reflected pathogen disgust, sexual disgust, and moral disgust. The authors replicated this result in a larger sample, and also demonstrated that the factor scores related to other constructs in a manner consistent with this

theoretical framework. In a third study, the authors trimmed the initial pool of 48 items to a 27 item measure and used a confirmatory factor analysis (CFA) to examine the factor structure of the items. Finally, in a fourth study, the authors presented the 21-item Three Domain Disgust Scale (TDDS), which is composed of three mildly to moderately correlated factors. The authors compared the TDDS with the DS. Although the DS originally included eight domains (food, animals, body products, death, body envelope violations, inappropriate sexual behavior, bad hygiene, magical thinking), it was later modified by Olatunji et al. (2007) by eliminating the four items on the sexual domain and two additional items that did not covary with other items. The final version of the revised DS (DS-R) includes 25 items reflecting three domains: core disgust, animal reminder disgust, and contamination disgust.

Tybur et al. (2009) demonstrated that all three of the domains measured on the DS-R are strongly interrelated – to the point of being non-distinct – and covary strongly with the pathogen domain of the TDDS. Hence, there is little evidence for the DS-R's purported multidimensionality. Rather than measuring distinct disgust domains, it appears that the DS-R largely reflects sensitivity to pathogen disgust. Sexual disgust, on the other hand, which is included under the umbrella of animal reminder disgust under the Rozin et al. (2008) model, does not relate the animal reminder domain of the DS-R when the pathogen domain of the TDDS is controlled for. Sensitivity to moral disgust also did not covary strongly with the DS-R. In sum, the authors demonstrated that the DS-R largely measures the same construct measured by the TDDS pathogen domain, but does not measure disgust responses reflected in the sexual or moral domains of the TDDS.

Although the TDDS has good internal consistency (above .80 for each seven-item factor), a well-fitting factor structure, demonstrates convergent and discriminant validity with sex and the DS-R, and is based on a more well-grounded theoretical framework than previous measures of disgust sensitivity, questions remain concerning its measurement properties and the nature of the constructs it measures.

In this manuscript, I present three studies that further explore this new measure. Each study includes data clarifying the nature of the constructs included on the TDDS and/or includes more information on the measurement properties of the scale than reported by Tybur et al. (2009). The first study explores the relationship between the three TDDS factors and the NEO PI-3 (McCrae, Costa, & Martin, 2005), which measures the dimensions of the Five Factor Model of personality and six facets contained within each dimension. The second study tests for relationships between the three TDDS factors and political ideology, which could theoretically relate to sensitivity to pathogen, sexual, and/or moral disgust. The third study tests for sex differences in the factor structure, factor loadings, factor means, and factor covariances of the TDDS using configural and structural CFA invariance analyses.

Chapter 6

Study 1: Disgust Sensitivity and the Five Factor Model

A large body of work has shown that individuals vary in the degree to which they find things disgusting. Variance in disgust responses toward items on Haidt et al.'s (1994) Disgust Scale has been shown to relate to a variety of psychological constructs. However, the nature of disgust sensitivity as a theoretical construct is not well understood. Only limited work has investigated disgust sensitivity in light of validated personality constructs. Notably, in developing the DS, Haidt et al. reported a positive correlation between the Eysenck Personality Questionnaire (Eysenck & Eysenck, 1975) neuroticism factor ($r = .23$) and a negative correlation with the psychoticism factor ($r = -.25$), but no relationship with the extraversion factor ($r = -.06$). They also reported a negative correlation with Zuckerman's (1979) sensation seeking scale ($r = -.46$). In exploring relationships between the DS and Five Factor Model (FFM) dimensions, as measured by the NEO PI-R (Costa & McCrea, 1992), Druschel and Sherman (1999) found disgust sensitivity to be positively related to neuroticism ($r = .45$), agreeableness ($r = .22$), and conscientiousness ($r = .35$), negatively related to openness ($r = -.28$), and unrelated to extraversion ($r = .06$). Additionally, studies have reported a sex difference on the DS, with women reporting greater disgust sensitivity than men (Haidt et al., 1994; Druschel & Sherman, 1999).

These findings provide some information about the nature of disgust sensitivity. As measured by the DS, individuals higher in disgust sensitivity are more prone to experience negative emotions, more compassionate and friendly, less regimented, and

less open to new ideas and experiences. However, two major issues limit the utility of these findings.

First, although the DS is used as a measure of disgust sensitivity, its item content suggests that it may measure some other construct as well. In constructing the measure, Haidt et al. (1994) designed half of the items with a true/false response format. Although these items were intended to reflect disgust sensitivity, several of them are arguably only tenuously related to disgust, and several seem to be more strongly related to Five Factor Model dimensions. Examples of such problematic items include “I might be willing to eat monkey meat, under some circumstances,” “It would bother me to see a rat run across my path in a park,” “It bothers me to hear someone clear a throat full of mucous,” “I think homosexual activities are immoral,” “I would go out of my way to avoid walking through a graveyard,” and “It would bother me to sleep in a nice hotel room if I knew that a man had died of a heart attack in that room the night before.” The reported correlations between total DS scores and other constructs may be driven by whatever underlies endorsements of such statements rather than by disgust sensitivity.

Second, although the DS is labeled as a measure of disgust sensitivity, it only addresses a limited component of the range of disgust experiences. Haidt et al. (1994) constructed the measure with the goal of tapping eight separate domains (food, animals, body products, sex, envelope violations, death, hygiene, and magical thinking), but an exploratory factor analysis suggested that the scale largely reflects a single factor, with limited domain specificity. Additionally, despite their treatment as adequate measures in a plethora of studies (e.g., Calder, Keane, Manes, Antoun, & Young, 2000; Fessler & Navarrete, 2003; Goldenberg et al., 2001; Rozin, Taylor, Ross, Bennett, & Heimadi,

2005; Troop et al., 2002), the subscale demonstrated unacceptably low internal reliability (Cronbach's alpha ranging from .34 to .60, with a mean of .48).

From the perspective offered by Tybur et al. (2009), the DS is largely a measure of sensitivity to pathogen disgust, but it also may include (unintended) additional elements tapping traits such as agreeableness, neuroticism, and openness to experience. Hence, although the DS was designed to be multidimensional, the dimensions it was intended to tap are largely related to pathogen disgust, but minimally (if at all) related to sexual disgust or moral disgust. All investigations into the nature of disgust sensitivity as a theoretical construct, as measured by the DS, have thus been limited in that they only have considered sensitivity to pathogen disgust, and have used a scale with questionable measurement properties.

In this study, I intend to explore the nature of disgust sensitivity with the TDDS, which more straightforwardly measures individual differences in disgust sensitivity, has a superior response format (i.e., seven point likert-type scales rather than a combination of three-point responses and true/false items), and includes not only sensitivity to pathogen disgust, but also sensitivity to sexual disgust and moral disgust. Specifically, I will test for relationships between the Five Factor Model dimensions of agreeableness, conscientiousness, extraversion, openness, and neuroticism – and facets subsumed within these dimensions – with sensitivity to pathogen, sexual, and moral disgust.

The purpose of this study is largely exploratory. Given that the TDDS is a new measure, not much is known about the nature of the constructs it measures. However, some predictions can be made regarding relations between FFM dimensions and the

factors of the TDDS. These predictions can be made based on prior empirical work and from the theoretical perspective motivating the development of the TDDS.

Theoretically, sensitivity to pathogen disgust may relate positively to neuroticism, negatively to openness to experience, and negatively to extraversion. As described by Schaller and Murray (2008), both openness to new ideas and frequent social contact may increase disease risk. Many social norms related to personal hygiene, food preparation, and sanitation may in fact function as cultural institutions designed to combat pathogens (Sherman & Billing, 1999). And high extraversion, while associated with numerous social benefits, is also associated with greater risk for negative outcomes, including illness (Nettle, 2006). Neuroticism is defined as negative emotional instability; neurotic individuals vacillate easily between states of fear, sadness, guilt, and anxiety. Such low thresholds for emotional activation may function to motivate rapid response to threat (Nettle, 2006), including pathogen threats. Thus, sensitivity to pathogen disgust may relate positively to neuroticism, negatively to extraversion, and negatively to openness, given their potential common relation to disease avoidance.

Sensitivity to sexual disgust may also relate negatively to openness. High openness potentially connotes fitness benefits – new ideas can be superior to current habits across several domains, be them child rearing, foraging, hygiene, or reproductive strategy – but can also increase potential costs, given established norms and manners of thinking may serve an important function for the local ecology. Sexuality is one domain in which a relatively constrained set of attitudes and behaviors have been selected for. Of all sexual behaviors possible, individuals tend to engage mostly in intercourse with members of the same species, of the opposite sex, of no close kinship, and of a similar

mate value. These constraints are reasonable in light of the energetic costs, opportunity costs, and disease costs of departing from normative behaviors. However, various other sexual behaviors (e.g., oral sex, kissing) may connote benefits as well, and individuals who are more open to new ideas and experiences – individuals who are more willing to pay the costs associated with departing from norms – may be less disgusted by less restrictive sexual behaviors.

Finally, sensitivity to moral disgust may be related to agreeableness and conscientiousness. Moral disgust appears to motivate avoidance and sanctioning of anti-social individuals and ideas, and behaviors associated with agreeableness seem to promote ingroup cooperation and cohesion (Heaven, 1996). Thus, individuals who are more invested in promoting ingroup cooperation may be more disgusted by anti-social acts like lying, cheating, stealing, and non-reciprocating. Similarly, conscientious individuals tend to value orderliness, responsibility, and self-control. Individuals who lie, cheat, and steal – who engaged in parasitic social behaviors – may threaten highly conscientious individuals, who invest high amounts of effort into productivity.

Additional predictions can be made based on past empirical results. Although results from Druschel and Sherman (1999) and Haidt et al. (1994) should be interpreted with caution given the ambiguity of the construct measured by the DS, they suggest that sensitivity to pathogen disgust – which is highly correlated with the DS – may relate positively to neuroticism, agreeableness, and conscientiousness, and negatively to openness. Cross-cultural data reported by Schaller and Murray (2008) suggest that sensitivity to pathogen disgust may relate negatively to both openness and extraversion. Miller et al. (2004) found that frequency of risky sexual behaviors – which are

theoretically more appealing to individuals low in sensitivity to sexual disgust – is related positively to extraversion, and negatively to openness and agreeableness. Additionally, in the development of the TDDS, Tybur et al. (2009) found that sensitivity to pathogen disgust was related to neuroticism, sensitivity to sexual disgust was related positively to agreeableness and conscientiousness, and negatively to openness, and sensitivity to moral disgust was related positively to conscientiousness, agreeableness, and extraversion. These results were obtained with a preliminary version of the TDDS, and with the BFI – a short form of the FFI. Better validated and reliable measures of disgust sensitivity and FFM dimensions may yield different results.

In this study, these predictions based on what is known or inferred about variation in disgust sensitivity and FFM dimensions will be tested using the TDDS and the NEO-PI-3 (McCrae, Costa, & Martin, 2005), which measures the dimensions of the FFM as well as six facets subsumed under each dimension. In addition to testing the predictions outlined above, this study is also intended to be somewhat exploratory and descriptive. Given the TDDS is a newly published measure, it is important to improve understanding of the constructs it measures, and the NEO-PI-3, a reliable and valid measure of the FFM offers the opportunity to gain information about disgust sensitivity as measured by the TDDS.

Method

Participants

Four hundred eighty four undergraduates (326 women; 154 men) at the University of New Mexico completed a paper-pencil survey in exchange for course credit. Participant age was typical for this type of sample ($M = 19.88$, $SD = 3.05$).

Measures

Participants completed the TDDS (see Appendix A) and the NEO-PI-3 (see Appendix B). The TDDS is a 21-item measure which includes seven items on each of three domains (pathogen, sexual, and moral). Each item is measured on a seven-point likert-type scale with 0 indicating that an item is “not at all disgusting” and 6 indicating that an item is “extremely disgusting.” The NEO-PI-3 is a 240-item measure that includes 48 items on each of five dimensions in the FFM. Each of these 48 items includes six sets of eight items that measure facets included under the FFM dimensions.

Results

Scores on the TDDS pathogen, sexual, and moral factors, and on the NEO-PI-3 FFM dimension factors are sufficiently reliable (all Cronbach’s alphas above .80). However, the facet scales on the NEO-PI-3 have a wide range of internal consistency (alphas below .60 and above .80). Given that differences in reliability can result in illusory differences in correlations (see Chapman & Chapman, 1973), and given that relationships between reliable measures are still attenuated by measurement error, correlations between the TDDS and NEO-PI-3 dimensions and facets were tested using structural equation modeling, which explicitly models measurement error and more accurately measures relationships between latent variables than do Pearson correlations between unit-weighted composites.

Within structural equation modeling, good model fit (i.e., a good correspondence between the observed covariances between variables and the covariances specified within the model being tested) is necessary for accurate parameter estimates (Kline, 2005). Given that multidimensional models using individual items as indicators rarely fit the

data well (see Ferrando & Lorenzo-Seva, 2000; McCrae, Zonderman, Costa, Bond, & Paunonen, 1996), items were bundled into parcels for each facet on the NEO-PI-3 and each factor on the TDDS. Parcels were created by averaging every third items on each TDDS factor and NEO-PI-3 factor to create nice parcels for the TDDS and 90 parcels for the NEO-PI-3. Because, even after bundling items, the NEO-PI-3 still had 90 item parcels, relationships between TDDS factors and NEO-PI-3 factors and facets were examined for each FFM dimension separately.

Two models were specified for each of the NEO-PI-3 factors (i.e., two models per dimension). In the first, the three TDDS factors was measured by three parcels each, and each of the six facets in the FFM dimension were measured by three parcels each, and all nine latent variables (three TDDS factors and six NEO-PI-3 facets) were free to covary. In the second, a tenth latent variable – the FFM dimension that the six latent variables measure – was specified as a second-order factor measured by the six facet-level latent variables, and the three TDDS factors were allowed to covary with each other and the FFM dimension. To summarize, for each of the FFM dimensions, one model allowed for relationships between the TDDS factors and NEO-PI-3 facets, and one model allowed for relationships between the TTDS factors and NEO-PI-3 higher order factors. Hence, a total of ten models were specified. The standardized observed covariances between the latent variables in the models are correlations between TDDS factors and each of the NEO-PI-3 factors and facets.

All ten models demonstrated acceptable fit, with CFIs no lower than .901, and RMSEAs no lower than .061. Thus, covariances between latent variables can be

interpreted as reliable estimates. All correlations are reported in Table 1, and all correlations are reported below as being significant or non-significant at the .05 level.

At NEO-PI-3 factor levels, sensitivity to pathogen disgust was significantly positively related to neuroticism, $r = .13$, and significantly negatively related to openness, $r = -.29$, but unrelated to agreeableness, $r = -.12$, extraversion, $r = -.05$, and conscientiousness, $r = .01$. Sensitivity to sexual disgust was significantly positively related to agreeableness, $r = .31$, neuroticism, $r = .14$, and conscientiousness, $r = .11$, and negatively related to openness, $r = -.36$, but unrelated to extraversion, $r = .08$. Sensitivity to moral disgust was significantly positively related to agreeableness, $r = .35$, conscientiousness, $r = .31$, and extraversion, $r = .14$, and negatively to neuroticism, $r = -.12$, but unrelated to openness, $r = .04$.

All correlations between NEO-PI-3 facets are reported in Table 1. These correlations were derived from the second five models, each of which allowed for covariances between the TDDS factors and each facet within a single FFM dimension. Given that each facet is highly related to the other five facets that also measure a FFM dimension, it is unclear if any extra information is obtained by interpreting facet-level relationships versus factor-level relationships. Thus a technique described by Cheung and Chan (2004) was employed to test the null hypothesis that each individual facet level covariance with each TDDS factor was the same as the other facet level correlations within the FFM dimension. The five facet-level models were rerun constraining the covariances between TDDS factors and NEO-PI-3 facets to equal the average covariance between the TDDS factor and the six facets. So, for example, after all covariances between Openness facets and TDDS factors were estimated, a model was run in which

the covariances between all six facets and sensitivity to moral disgust were constrained to equality, all six facets and sensitivity to sexual disgust were constrained to equality, and all six facets and sensitivity to pathogen disgust were constrained to equality. Chi-square tests of model fit were compared with the model in which these covariances were freely estimated, and Lagrange Multiplier (LM) tests were conducted to determine which (if any) covariances should be freely estimated rather than fixed. This technique is analogous to a test of differences between dependent correlations.

Four of the five models in which the covariances were fixed to the average separate covariance between facets and TDDS factors fit the data less well than models in which the covariances were freely estimated (all χ^2_{Δ} , with 18 degrees of freedom, were above the critical value of 28.87). Only the model in which the agreeable facet covariances were constrained to equality did not fit the data worse, $\chi^2_{\Delta}(8, N = 484) = 24.17, p > .05$. The LM tests for the four poorer fitting models were examined to determine which facet level covariances were unique. In total, only eight of the 90 facet-TDDS covariances were different from the other covariances within the FFM dimensions, and none of the differences were striking. These included unique relationships between sensitivity to moral disgust and fantasy (openness; $r = -.14$), ideas (openness; $r = .14$), anxiety (neuroticism; $r = .01$), and between sensitivity to sexual disgust and feelings (openness; $r = -.09$), angry hostility (neuroticism; $r = -.04$), impulsiveness (neuroticism; $r = -.01$), excitement seeking (extraversion; $r = -.25$), and deliberation (conscientiousness; $r = .25$).

Table 1.
Correlations Between TDDS Factors and NEO-PI-3 Factors and Facets

NEO-PI-3 Factor/Facet	Moral	Sexual	Pathogen
Agreeableness	0.35	0.31	-0.12
Trust	0.17	0.08	-0.17
Straightforwardness	0.34	0.34	-0.05
Altruism	0.30	0.22	-0.05
Compliance	0.16	0.18	-0.12
Modesty	0.24	0.23	-0.05
Tender-Mindedness	0.15*	0.16	-0.12
Openness	0.04	-0.36	-0.29
Fantasy	-0.14*	-0.29	-0.22
Aesthetics	0.04	-0.13	-0.17
Feelings	0.10	-0.09*	-0.17
Actions	-0.09	-0.34	-0.22
Ideas	0.14*	-0.32	-0.25
Values	-0.11	-0.41	-0.24
Neuroticism	-0.12	0.14	0.13
Anxiety	0.01*	0.2	0.17
Angry Hostility	-0.16	-0.04*	0.14
Depression	-0.10	0.09	0.04
Self-Consciousness	-0.08	0.11	0.08
Impulsiveness	-0.12	-0.01*	0.13
Vulnerability	-0.17	0.21	0.16
Extraversion	0.14	0.08	-0.05
Warmth	0.22	0.13	-0.11
Gregariousness	0.04	0.05	0.01
Assertiveness	0.08	-0.05	-0.09
Activity	0.10	0.01	0.00
Excitement-Seeking	-0.01	-0.25*	0.03
Positive Emotions	0.13	0.19*	-0.05
Conscientiousness	0.31	0.11	0.01
Competence	0.25	0.01	-0.06
Order	0.16	0.16	0.11
Dutifulness	0.41	0.12	0.06
Achievement Striving	0.33	0.13	0.04
Self-Discipline	0.22	0.06	-0.03
Deliberation	0.27	0.25*	-0.01

Note: Bolded font indicates significance at the .05 level. Asterisks indicate that facet covariances are significantly different than the average of others within that factor

Discussion

To an extent, the patterns of relationships between FFM dimensions and disgust domains were consistent with purported functions of disgust. Interpreting only relationships that accounted for at least eight percent of the variance in TDDS factors (i.e., correlations above .28), individuals who were more disgusted by moral transgressions were more agreeable – more trusting, friendly, and generous – and more oriented toward organization, efficiency, and hard work. This suggests that those individuals especially likely to pay costs imposed by the anti-social are especially disgusted, and, conceivably, motivated to avoid and punish such individuals. However, sensitivity to moral disgust was not (or not strongly) related to openness to new ideas, emotional instability, or extraversion.

Individuals who were more disgusted by non-normative sexuality were also less open to new ideas. Such individuals were less dreamy and imaginative (fantasy facet), less artistic and original (aesthetics facet), less adventurous and optimistic (actions facet), less inventive and curious (ideas facet), and more conservative and cautious (values facet). Notably, of the openness facets, only feelings (being excitable, spontaneous, insightful), which is also related to neuroticism and extraversion (Costa & McCrae, 1992), was unrelated to sensitivity to sexual disgust. These findings are consistent with previous research indicating that less sexually adventurous individuals are less open to experience (Miller et al., 2004). Agreeableness was also related to sensitivity to sexual disgust. This was not predicted from theory, but is consistent with results from Tybur et al. (2009). Perhaps deviations from normative sexuality threatens to impose costs on individuals who are follow social guidelines, and individuals who are more invested in

prosociality are more avoidance of such deviations from sexual norms. Sensitivity to sexual disgust was only weakly related, or unrelated, to neuroticism, extraversion, and conscientiousness.

Individuals who were more disgusted by infection risks were also less open to experience, and this relationship was quite stable across openness facets. This lends further support to arguments by Schaller and Murray (2008) and Thornhill et al. (2009) that orientation toward traditional ideas – and a lack of interest in novelty – may function to reduce threats posed by diseases. Such “conventions” may be locally developed (e.g., only eat meat if it is prepared in this specific manner; eat specific foods when they are accompanied by anti-microbial seasonings) or may be norms that are theoretically stable across culture (e.g., don’t play with feces). Contrary to other reasonable predictions – that lower extraversion and higher neuroticism would be associated with lower sensitivity to pathogen disgust – this was the only strong relationship found between sensitivity to pathogen disgust and FFM dimensions. This suggests that, at least in the population sampled from in this study, disease avoidance concerns may not influence the degree to which individuals are oriented to socialize and with others, or the ease with which people experience negative emotions.

The lack of symmetry between these results and those found using the DS (Druschel & Sherman, 1999) further suggests that the construct measured with the DS, while strongly related to sensitivity to pathogen disgust, is somewhat different. Several of the binary items on the DS ask about being “bothered” by other individuals (e.g., someone clearing their throat; someone taking a glass eye out of their eye socket); such items may influence how the DS related to agreeableness and neuroticism. It is unclear

why the DS would relate to conscientiousness, as reported by Druschel and Sherman (1999), but the correlation between sensitivity to pathogen disgust and conscientiousness was .01 in this study.

Chapter 7

Study 2: Disgust sensitivity and political ideology

Like research on disgust, research related to political ideology has recently become much more common in psychology (Jost, Nosek, & Gosling, 2008). Researchers have gained a better understanding of the genetic bases of ideology (Alford, Funk, & Hibbing, 2005; Bouchard, Segal, Tellegen, McGue, Keyes, & Krueger, 2003), the neural correlates of ideology (Amodio, Jost, Master, & Yee 2007) how it ideology develops across the lifespan (Block & Block, 2006), and how it relates to a number of personality constructs, including avoidant attachment (Thornhill & Fincher, 2008), openness to experience and conscientiousness (Carney, Jost, Gosling, & Potter, 2008; Jost, 2006). Ultimately, syntheses of such findings can improve understanding of the motivations of ideology and its nature as a personality construct (Jost, Glaser, Kruglanski, & Sulloway, 2003; Jost et al., 2008).

Given the increasing interest in both disgust and ideology, an investigation of how ideology relates to disgust may mutually inform both areas of study. Despite recent advances in the understanding of the function of disgust, there remain a number of questions regarding how the emotion operates across different contexts. An examination of how disgust operates in the political realm can improve the understanding of how disgust operates specifically in politics, and perhaps how the emotion functions in general. Similarly, despite recent advances that have placed ideology within a nomological network, there is no consensus as to what motivates ideology or what the function of ideology is. Given the disgust-evoking nature of many ideological concepts –

and given the varied nature of disgust – differential relationships between ideology and varied disgust domains may inform theoretical models of ideology.

Different theoretical models of ideology suggest that each disgust domain may relate to conservatism. Some have suggested that, among other things, ideologically relevant traits such as collectivism, xenophobia, and adherence to localized social norms function to neutralize threats posed by pathogens (e.g., Faulkner, Schaller, Park, & Duncan, 2004; Fincher, Thornhill, Murray, & Schaller, 2008; Navarrete & Fessler, 2006; Schaller & Murray, 2008; Thornhill et al., 2009). This model implies that certain norms (e.g., food preparation, hygiene and grooming) may function to neutralize threats posed by pathogens within a specific environment, and xenophobia may function to neutralize the threat of infection from outgroups possessing novel pathogens for which the ingroup does not possess sufficient immunity. Researchers have found empirical support for this model: cross-culturally, nations' pathogen prevalence is positively related to the average conservatism (Thornhill et al., 2009) and collectivism (Fincher, Thornhill, Murray, & Schaller, 2008) of individuals within those cultures, and negatively related to average openness to experience (Schaller & Murray, 2008). Given that disgust toward pathogen cues presumably functions to motivate disease avoidance (Curtis & Biran, 2001; Oaten et al., 2009; Tybur et al., 2009), those who are more sensitive to pathogen disgust (and, presumably, more invested in avoiding disease) may also be more conservative. Moreover, associations have been found between measures of disgust sensitivity conceptually and empirically related to disease-avoidance and conservatism (Inbar et al., in press) and Right Wing Authoritarianism (Hodson & Costello, 2007).

At the same time, many “hot button” issues for contemporary social conservatives concern disapproval of “deviant” sexuality (e.g., pornography, anal sex, homosexuality, sex education), and conservatism is associated with negativity toward non-normative sexual practices and sex in general (Haidt & Hersh, 2001; Jost et al., 2008). Additionally, sexual strategies have been shown to relate to ideology. Individuals higher in Social Dominance Orientation have more traditional sexual strategies, which produce unequal social relationships between men and women (Pratto & Hegarty, 2000). Given that the sexual domain of the TDDS largely includes items related to non-traditional sexual practices (e.g., oral sex, anal sex, unwanted sexual contact), conservatism may relate to sensitivity to sexual disgust.

Further, conservatism predicts the subjective importance of “moral values” in voting decisions (Haidt & Graham, 2007). Moreover, conservatives can be viewed as “ingroup specialists” who may be more invested in group-level norms related to honesty and reciprocity (Thornhill & Fincher, 2007). Given that the moral domain of the TDDS reflects disgust toward acts violating pro-social norms related to honesty and reciprocity, conservatism may also relate to sensitivity to moral disgust.

Finally, it is unclear how disgust expressed in the political realm relates to the domains measured by the TDDS. That is, the disgust expressed toward politically relevant issues may reflect pathogen, sexual, or moral disgust, or perhaps none of the domains included in the TDDS. The current study thus includes three broad goals: 1) to clarify the relationship between conservatism and the three domains of disgust measured on the TDDS, 2) to use disgust sensitivity as a means of testing several hypotheses related to the nature of conservatism, and 3) to examine the relationship

between disgust toward political issues and disgust toward pathogens, sexuality, and immorality.

Method

Participants

Two hundred fifty three undergraduate students (211 women; mean age = 20.4 years) from a public state university participated in exchange for course credit. Participants completed the study online in exchange for class credit in late 2007 and early 2008.

Measures

Ideology has been measured in several ways, often with a single, Likert-type “liberal-conservative” item (e.g., Carney et al., 2008), with measures that assess attitudes toward a variety of political issues (e.g., Eysenk, 1951; Thornhill & Fincher, 2007; Wilson, 1989), or with some combination of the two (e.g., Block & Block, 2006; Tybur et al., 2007; see Knight, 1999, for a summary). In this study, conservatism was measured with 13 items (see Appendix C), 4 of which asked participants their agreement with broad statements regarding ideology or political party preference (e.g., I consider myself to be politically liberal; I often identify with the policies of the Republican Party) and 9 of which asked participants their agreement with statements about specific political issues (e.g., I think that our gun control laws are too strict; I think that homosexuals should have the same marriage rights as heterosexuals). Each item was scored on a 0 (strongly disagree) to 6 (strongly agree) Likert-type scale. A principle components analysis (PCA) on the 13 items suggested that they reflected a unidimensional construct, with the top four eigenvalues being 4.31, 1.41, 1.18, and 1.01. After reverse scoring items

for which high scores indicated liberalism, the 13 items were unit-weighted to create a measure of conservatism ($\alpha = .81$).

Several disgust measures were also collected. Participants completed the TDDS. Seven items in each domain were unit-weighted to form three internally reliable composites ($\alpha = .83, .85, .87$, respectively). Participants also reported their disgust responses to 5 political items (see Appendix D) designed to be objectionable to liberals (The 2003 invasion of Iraq; Tax cuts for the wealthy; then-current President George W. Bush; Republicans' values; Teaching intelligent design in high school classrooms) and 5 designed to be objectionable to conservatives (Abortion in the first trimester of pregnancy; Burning the American flag; Former U.S. President Bill Clinton; Gay marriage; Democrats' values). Separate PCAs on each of the five item sets suggested that they measured unidimensional constructs, with eigenvalues of 2.41, .86, .80, .53, and .40 for disgust toward liberals, and eigenvalues of 2.51, .96, .78, .47, and .29 for disgust toward conservatives. Both item sets were separately unit-weighted ($\alpha = .72$ for both measures; the two measures were correlated, $r = -.38$). These composite variables are subsequently referred to as disgust toward conservatives and disgust toward liberals.

Results

How does the Three Domain Disgust Scale relate to conservatism?

Bivariate correlations suggested that conservatism is related to sensitivity to sexual disgust, $r = .25, p < .001$, and moral disgust, $r = .13, p < .05$, but not pathogen disgust, $r = .06, p = .31$. Given that these disgust domains share some statistical and theoretical overlap, conservatism was then regressed simultaneously on sensitivity to

pathogen disgust, sexual disgust, and moral disgust, and sex¹ and age (see Table 2). The relationship between sensitivity to moral disgust and conservatism was no longer significant, $r_{sp} = .06$, $p = .34$, and the relationship between sensitivity to pathogen disgust and conservatism remained non-significant, $r_{sp} = -.05$, $p = .43$. Only sensitivity to sexual disgust, $r_{sp} = .23$, $p < .001$ was uniquely related to conservatism.

Table 2.
Bivariate and Semi-Partial Correlations Between Sensitivity to Disgust and Conservatism

Predictor	r	p	r_{sp}	p
Participant Sex	0.01	0.97	0.15	0.01
Participant Age	-0.15	0.02	-0.10	0.10
Sensitivity to Pathogen Disgust	0.06	0.31	-0.05	0.43
Sensitivity to Sexual Disgust	0.25	<.001	0.23	<.001
Sensitivity to Moral Disgust	0.13	0.03	0.06	0.34

How does political disgust relate to pathogen, sexual, and moral disgust?

The next analyses focused on how disgust toward liberals and conservatives relates to pathogen, sexual, and moral disgust. First, an omnibus repeated-measures MANCOVA was conducted to determine how disgust sensitivity predicted disgust toward liberals and disgust toward conservatives (see Table 3). The two political disgust variables were treated as levels of a within-subjects factor, participant sex was treated as a between-subjects factor, and age, conservatism, and sensitivity to pathogen disgust, sexual disgust, and moral disgust were treated as continuous factors, as were interactions between conservatism and each of the three disgust domains. This analysis tested for two- and three-way interactions involving level of political disgust. For example,

¹ Fisher z-tests for differences between independent correlations suggested no significant sex differences between conservatism and the three disgust domains.

interaction effects would indicate that a specific domain of disgust differentially relates to the two political disgust variables. There was a strong two-way interaction between conservatism and level of the within-subjects factor, $F(1, 243) = 487.34, p < .001$ (conservatism was positively related to disgust toward liberals, $\beta = .64, p < .001, r^2_{sp} = .36$, but negatively related to disgust toward conservatives, $\beta = -.72, p < .001, r^2_{sp} = .46$; see Table 2), but none of the other predictors differentially related to disgust toward liberals versus conservatives. Only one three-way interaction was significant: sensitivity to moral disgust was moderated by conservatism differently in predicting disgust toward liberals versus disgust toward conservatives, $F(1, 243) = 13.62, p < .001$.

Table 3.
Unstandardized and Standardized Regression Weights Predicting Disgust Toward Liberals and Disgust Toward Conservatives

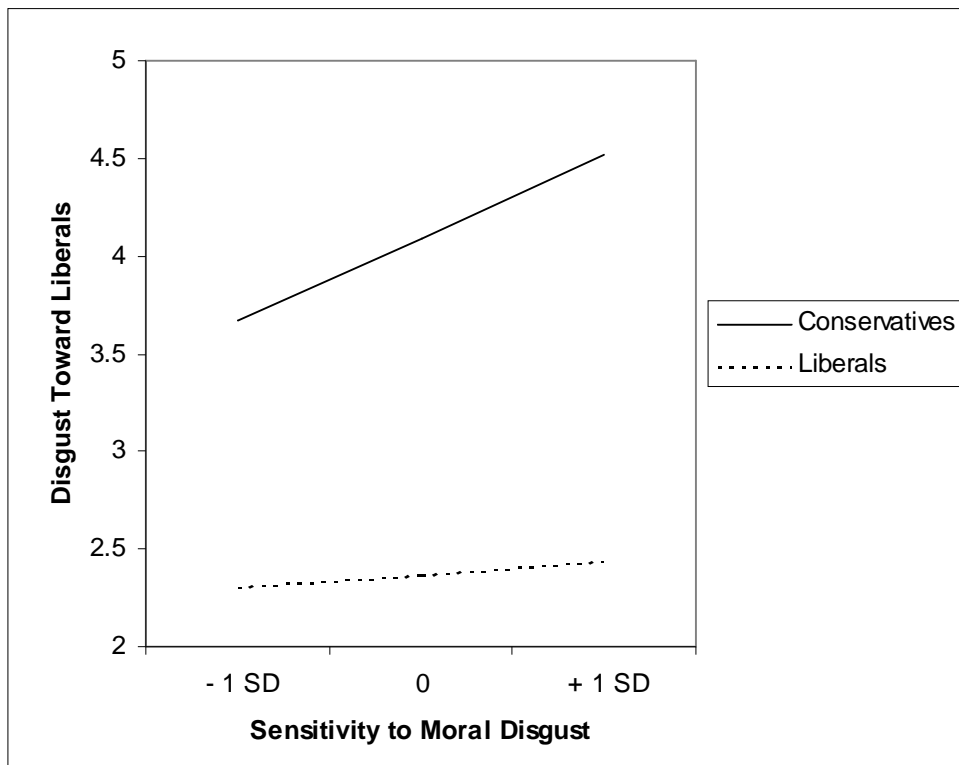
Predictor	Disgust Toward Liberals			Disgust Toward Conservatives		
	b	B	p	b	B	p
Participant Sex	0.32	0.09	0.07	0.18	0.05	0.33
Participant Age	-0.01	-0.02	0.60	-0.01	-0.03	0.53
Sensitivity to Moral Disgust	0.11	0.10	0.04	0.17	0.16	<0.01
Sensitivity to Sexual Disgust	0.24	0.25	<0.01	0.10	0.11	0.08
Sensitivity to Pathogen Disgust	0.01	0.01	0.81	<0.01	<0.01	0.97
Conservatism	1.28	0.64	<0.01	-1.39	-0.72	<0.01
Moral Disgust * Conservatism	0.22	0.16	<0.01	-0.10	-0.08	0.13
Sexual Disgust * Conservatism	0.06	0.05	0.30	0.07	0.05	0.29
Pathogen Disgust * Conservatism	<0.01	<0.01	0.96	0.02	0.01	0.81

Note: Bolded font indicates that the effects differ significantly across levels of the dependent variable – across disgust toward liberalism and disgust toward conservatism

Two follow-up analyses were then conducted to investigate this three-way interaction, each regressing one level of political disgust (i.e., disgust toward liberalism or toward conservatism) on each of the factors included in the omnibus test (see Table 2 for effects). For disgust toward liberals, only sensitivity to moral disgust was moderated by conservatism, $t(243) = 3.54, p < .001$. Tests of the simple slopes of sensitivity to

moral disgust were then computed at different levels of conservatism – at one standard deviation above (“conservatives”) and below (“liberals”) the midpoint of the conservatism composite – to probe this two-way interaction. For conservatives, sensitivity to moral disgust was related to disgust toward liberals, $\beta = .31, p < .001, r^2_{sp} = .03$; for liberals, sensitivity to moral disgust was unrelated to disgust toward liberalism, $\beta = .05, p = .65, r^2_{sp} < .01$ (see Figure 2).

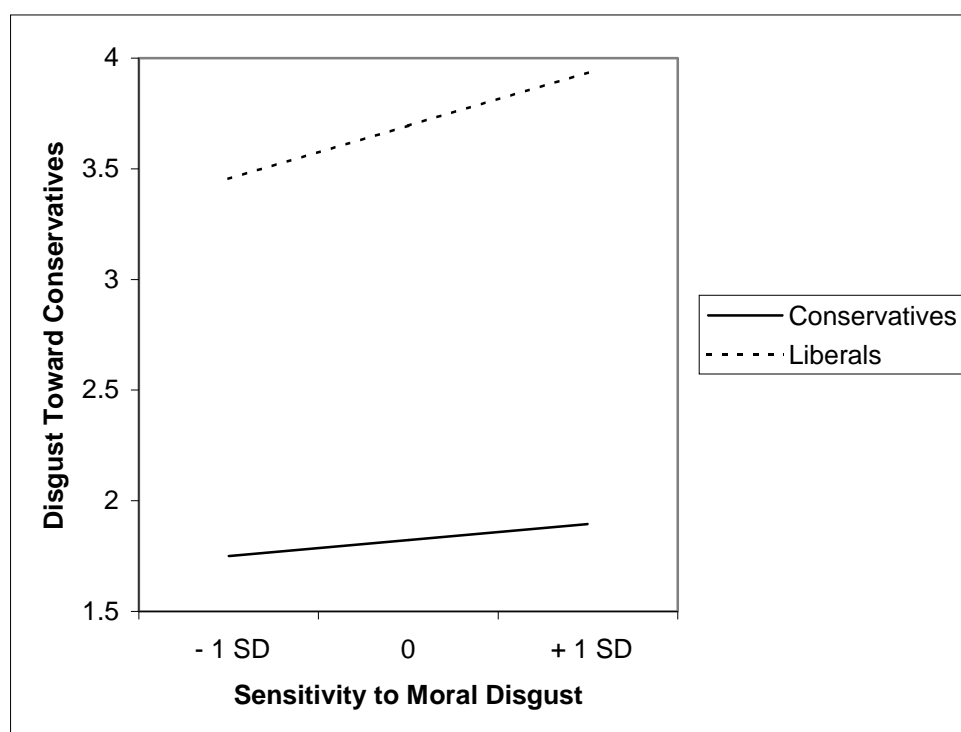
Figure 2. Disgust toward liberals as a function of sensitivity to moral disgust for conservatives ($\beta = .31, p < .001, r^2_{sp} = .03$) and for liberals ($\beta = .05, p = .65, r^2_{sp} < .01$)



For disgust toward conservatives, the interaction between conservatism and sensitivity to moral disgust did not reach conventional levels of statistical significance, $t(243) = 1.51, p = .13$. However, given the marginal significance of the interaction – and the results obtained when disgust toward liberalism was treated as the dependent measure – the simple slopes of sensitivity to moral disgust were analyzed at the same levels of

conservatism used in the previous analysis. The pattern was opposite, but complimentary, to that found in the first analysis: for conservatives, sensitivity to moral disgust was *unrelated* to disgust toward conservatives, $\beta = .06$, $p = .49$, $r^2_{sp} < .01$; for liberals, sensitivity to moral disgust *was* related to disgust toward conservatives, $\beta = .19$, $p < .01$, $r^2_{sp} = .02$ (see Figure 3).

Figure 3. Disgust toward conservatism as a function of sensitivity to moral disgust for conservatives ($\beta = .06$, $p = .49$, $r^2_{sp} < .01$) and for liberals ($\beta = .19$, $p < .01$, $r^2_{sp} = .02$)



Discussion

Of the TDDS factors, only sensitivity to sexual disgust was uniquely related to conservatism. Thus, while conservatives were more disgusted than liberals by pornography, oral sex, and promiscuity, they were not more disgusted by lying, cheating, and stealing, or by feces, blood, and body odor. These results have implications how disgust sensitivity is understood, and for several theories of political ideology.

First, the relationship between conservatism and sensitivity to sexual disgust is consistent with the findings from Study 1, which indicated a relationship with openness, and the strongest facet-level correlation (though not significantly differentiated from the other facets), was that with the values facet, which is described by Costa and McCrae (1992) as liberalism. It is also consistent with findings by Jost et al. (2008) that conservatism is associated with negativity toward erotica and sexual activity. This underscores arguments by Haidt and Hershey (2001) that attitudes toward sexuality may play an important role in current ideologically based culture wars. This finding suggests that it may be worthwhile to investigate how conservatism relates to regulations of sexuality and reproductive behavior. Specifically, as Pratto and Hegarty (2000) suggest, political ideology may play a key role in sociocultural regulation of mating strategies.

Although models suggesting that conservatism functions to neutralize pathogen threats would predict a relationship between sensitivity to pathogen disgust and conservatism, no such relationship was found in this study. There are several potential explanations for this null finding. Whereas most of the research based on this model has investigated cross-cultural infectious disease prevalence and constructs related to conservatism, such as collectivism and openness to experience (Schaller & Murray, 2008; Thornhill et al., 2009; Fincher et al., 2008) – and results from Study 1 were consistent, finding an intracultural relationship between openness and sensitivity to pathogen disgust – the current study investigated relations with self-reported political ideology. It is possible that several traits related to conservatism (e.g., RWA and SDO, as found by Hodson and Costello, 2007) are related to disease-avoidance, but political self-identification and policy preferences are not.

These results are also somewhat contradictory to those found by Inbar et al. (in press), who reported a relationship between conservatism and short-forms of the DS (Haidt et al., 1994). However, it is difficult to interpret results using the DS. As discussed previously, the nature of the construct(s) measured by the DS is unclear, and it is possible that a relationship between conservatism and the DS is driven by some of the more construct ambiguous items on the DS (e.g., “I try to avoid letting any part of my body touch the toilet seat in a public restroom, even when it appears clean). Additionally, the form of the DS used by Inbar et al. included items related to sexuality, which likely tap a disgust domain empirically and theoretically distinct from pathogen disgust.

It may be worthwhile to reexamine the interpretation of results demonstrating a strong relationship between nations’ ideologically-relevant traits and infectious disease rates. Although it has been suggested that conservatism motivates physical avoidance of outgroup members because outgroup members carry novel pathogens, the evidence for this hypothesis has mostly examined parasites that are not primarily transmitted via direct contact between humans. For example, Fincher et al. (2008) found a robust relationship between nations’ collectivism and pathogen prevalence. However, the index of pathogen prevalence included nine pathogens (leishmaniasis, trypanosomes, malaria, schistosomes, filariae, leprosy, dengue, typhus and tuberculosis), most of which are vector-borne parasites that rely on non-human vectors for transmission (e.g., mosquitoes for malaria and dengue; snails for schistosomiasis). Perhaps nations with higher levels of vector-borne pathogens also have higher levels of interpersonally transmitted pathogens. Or perhaps the relationships between nations’ pathogen prevalence and traits such as collectivism reflects something other than adaptation for physical avoidance of outgroups (e.g.,

adherence to group norms that function to neutralize local pathogen threats, an explanation also proposed by Fincher et al., 2008, and Schaller and Murry, 2008).

Despite conservatives' greater emphasis on "moral issues" in political behavior (Haidt & Graham, 2007), they are not more disgusted by violations of norms related to honesty and reciprocity – violations that largely compose the moral domain of the TDDS. This is consistent with arguments made by Haidt and colleagues (e.g., Graham & Haidt, 2009; Haidt & Graham, 2007; Haidt & Joseph, 2007) that, of five purported moral intuitions (harm/care, fairness/reciprocity/, ingroup/loyalty, authority/respect, and purity/sanctity), liberals and conservatives both use fairness/reciprocity and harm/care in moral decision making. Hence, while liberals and conservatives do not demonstrate greater sensitivity to moral disgust as measured on the TDDS, conservatives may moralize a wider array of issues.

In contrast with the modest associations between conservatism and the domains on the TDDS, conservatism strongly predicted disgust toward ideologically divergent political issues. In itself, this should not be surprising: obviously, those who identify as liberals should be expected to report more disgust toward conservative principles, and vice-versa. However, the moderating effect of moral disgust – but not sexual or pathogen disgust – on the relationships between conservatism and disgust toward political ideas informs both the validity of the moral domain of the TDDS and the nature of disgust expressed in the political realm.

The moral domain of the TDDS includes items concerning anti-social behaviors such as lying, cheating, and stealing. Hence, none of the items concern issues that seem specific to liberals or conservatives. And indeed, the weak relationship between

conservatism and sensitivity to moral disgust approached zero when controlling for other disgust domains. Thus, although the items on the moral domain are endorsed as disgusting, are similar to concepts that are described as disgusting and associated with facial expressions of disgust in children as young as six (Danovitch & Bloom, 2009), and are similar to concepts that activate neural regions associated with disgust (Schaich Borg et al., 2008) and facial expressions associated with disgust (Chapman et al., 2009), it has been unclear if such disgust responses relate to disgust responses to culturally specific issues such as flag burning. The results of this study suggest that they do: liberals who reported greater disgust to apolitical moral issues also reported greater disgust toward conservatives and tax cuts for the wealthy; conservatives who reported greater disgust to apolitical moral issues also reported greater disgust toward liberals, abortion, and gay marriage. These relationships mutually inform the nature of conservatives' and liberals' attitudes toward politically conflicting individuals and issues: those who are especially disgusted by lying, cheating, and stealing are also especially disgusted by individuals and issues of opposing ideologies. This implies that the same processes affecting sensitivity to moral disgust – perhaps investment in social norms, group cohesion, honesty, and reciprocity – also affect the strength of disgust toward conflicting ideologies.

Future investigations in this area may further explore the results found in this study. For example, the relation between sensitivity to sexual disgust and conservatism, in concert with previous findings relating sexuality to conservatism, suggests a fruitful direction for future research on ideology. Because causal relationships cannot be inferred from the results of this study, it is not clear if disgust toward sexuality leads to conservatism (e.g., individuals with more restricted attitudes toward sex gravitate

toward an ideological orientation that regulates sex), conservatism leads to disgust toward sexuality (e.g., conservatives are more oriented toward “traditional” norms, including those related to sexuality), or some unexplored construct mediates the relationship between the two.

Further, future research may contrast the lack of findings of a relationship between sensitivity to pathogen disgust and conservatism in this study with the consistent findings of a relationship between cultures’ disease loads and their conservatism (or a construct related to conservatism). It is possible that the same disease-relevant factors influencing group-level conservatism do not influence individual differences in conservatism within a group. Or some quality specific to the culture sampled in this study (e.g., low baseline pathogen prevalence) may attenuate the relationship between sensitivity to pathogen disgust and conservatism.

Chapter 8

The Structure of the Three Domain Disgust Scale

Whereas Studies 1 and 2 primarily explored relations between the TDDS and other variables in an effort to better understand the nature of disgust sensitivity as a theoretical construct, Study 3 addresses the measurement properties of the TDDS.

Tybur et al. (2009) developed the measure by starting off with a pool of over 100 disgust elicitors suggested by various undergraduate students, graduate students, professors, and community members. These items were reduced to 58 to minimize redundancies, eliminate locally idiosyncratic items, and remove items that would obviously not yield meaningful variance on a self-report measure. The 58 items were given to a sample of undergraduates to rate on the same response scale used for the TDDS, and were further parsed to 48 items after removing items with highly non-normal distributions. After examining factor loadings across two samples, these 48 items were further reduced to 27 items. Two items from each factor were further removed to minimize correlated error variances, the final 21-item TDDS was created.

The measurement properties of the TDDS were examined using a sample of 507 undergraduate psychology students. In this sample, a CFA on the TDDS demonstrated good model fit, all factors had acceptable internal consistency, and all items loaded moderately to strongly on only the appropriate factors.

These results are consistent with good measurement properties, but two issues constrain their utility: 1) they were gathered on a sample of undergraduate college students relatively homogenous on a number of traits (e.g., age, geographic location), and, perhaps more importantly, 2) they did not examine how the TDDS might operate

differently for the sexes. A key and consistent finding reported by Tybur et al. (2009) was the sizeable sex difference in sensitivity to sexual disgust, as compared to modest sex differences in sensitivity to pathogen and moral disgust. Given these mean sex differences – and the vastly different costs paid by the sexes for sexual “mistakes” – it is important to examine sex differences more nuanced measurement properties of the TDDS.

In this final study, samples from Studies 1 and 2, from Tybur et al. (2009), and from a number of unpublished data sets were combined to allow for appropriate tests of invariance in the factor structure, item loadings, and factor variances and covariance across the sexes. Two of these samples were obtained from a more age-varied sample than that used in Tybur et al. (2009) and Studies 1 and 2 of this manuscript, thus allowing for greater generalizability.

Method

Participants

Four thousand one hundred fifty five participants (64.2% female) were pooled from nine separate samples, seven of which were undergraduate psychology student samples, and two of which were Internet samples. Mean participant age was 28.23 years ($SD = 11.28$), with a range from 18 to 78. All participants completed the TDDS and reported their age and sex.

Results

First, internal consistency was separately estimated for the sexes for all three TDDS factors. All three factors demonstrated good internal consistency across both sexes ($\alpha = .81, .86, \text{ and } .87$ for men; $\alpha = .81, .80, \text{ and } .86$ for women, for pathogen, sexual, and

moral disgust, respectively), though sensitivity to sexual disgust was somewhat more internally consistent for men than for women.

Next, mean sex differences for the unit-weighted composites were compared using separate independent samples t-tests. The sexes differed on each domain (all p 's < .00001). Consistent with results reported by Tybur et al. (2009), the degree to which the sexes differed on disgust sensitivity varied across domains, $F(2, 4162) = 181.61, p < .001$, with small sex differences on the pathogen factor, $d = .20$, and moral factor, $d = .14$, but a large sex difference on the sexual factor, $d = .74$.

Subsequent analyses concerned the dimensionality of the measure, the factor loadings of the measure, and the variances and covariances of the three TDDS factors. Although such tests could be conducted by visually comparing eigenvalues and factor loadings from an exploratory factor analysis, a confirmatory factor analysis (CFA) approach is necessary for significance tests of invariance in factor loadings and variances across groups.

An overall CFA on the TDDS was run using EQS 6.1. Each item was constrained to load on only the factor it is hypothesized to load. For the entire sample, the data fit the model well, $\chi^2(186, N = 4163) = 2824.77, p < .01$, CFI = .91, RMSEA = .058, SRMR = .048. This is comparable to – and even slightly better than – fit reported by Tybur et al. (2009). When analyzed separately for each sex, the model fit well for men, $\chi^2(186, N = 1395) = 1044.35, p < .01$, CFI = .94, RMSEA = .058, SRMR = .047, and for women, $\chi^2(186, N = 2668) = 1146.56, p < .01$, CFI = .91, RMSEA = .061, SRMR = .053. Hence, there is evidence that the TDDS measures the same number of dimensions for men and

women (dimensional invariance), and the same items load on each dimension between the sexes (configural invariance).

Next, metric invariance was examined by constraining the factor loadings of each scale item to equality across the sexes (i.e., forcing the items to have the same loadings for men and women). Evidence for complete metric invariance would require that this model fit the data equally well as the model in which factor loadings are free to vary between the sexes. First, a baseline model in which the loadings are free to vary across the sexes, and this model is compared to the constrained model. The baseline model demonstrated acceptable fit, $\chi^2(372, N = 4163) = 3068.44, p < .01, CFI = .91, RMSEA = .060, SRMR = .052$, and was tested against a metrically invariant model.

To identify a model, each factor requires one unstandardized factor loading to be constrained to 1 (i.e., the marker variable for a factor; Kline, 2005). Thus, 18 items (six loadings per factor) were constrained to equality, with the unstandardized loading of the first item on each TDDS factor constrained to one. This model did not fit the data as well as the previous, $\chi^2_{\Delta}(18, N = 4163) = 119.27, p < .01$. Because the necessary constraint of a single item per factor to one (and thus to equality) does not allow for a test of invariance in the factor loading across groups for these variables, multiple models were evaluated in which different items were treated as the marker variables. For the final analysis of metric invariance, only the items demonstrating the least invariance in loadings were treated as marker variables.

In total, seven loadings were not invariant (i.e., were different) across the sexes (see Table 4 for all item loadings for both sexes). The items were, with men's and women's loadings, respectively: Deceiving a friend (.66 versus .71); A stranger of the

opposite sex rubbing your thigh in an elevator (.76 versus .60); Having anal sex with someone of the opposite sex (.63 versus .56); Hearing two strangers having sex (.78 versus .62); Performing oral sex (.72 versus .46); Seeing a cockroach run across the floor (.61 versus .54); and Accidentally touching a person's bloody cut (.66 versus .63).

Although these loadings were somewhat different (indeed, different enough that constraining them to equality reduced model fit), they were still consistently of moderate to high magnitude. When all loadings except these seven were allowed to vary between the sexes, the model fit as well as that in which all loadings were free to vary, $\chi^2_{\Delta}(11, N = 4163) = 7.52, p > .05$.

Next, differences between factor variances and covariances were examined.

Maintaining the factor loading equality constraints from the previous partial metrically invariant model, the factor variances and covariances were constrained to equality for the sexes. This model did not fit the data as well as the previous, $\chi^2_{\Delta}(6, N = 4163) = 20.44, p < .01$, indicating sex differences in factor variances and covariances. LM tests indicated that the sexual and moral factor variances differed across the sexes, as did the covariances between the sexual and moral factors ($r = .39$ for men versus $.35$ for women) and sexual and pathogen factors ($r = .55$ for men versus $.49$ for women). Allowing these four parameters to differ improved model fit to that observed in the partial metrically invariant model, $\chi^2_{\Delta}(2, N = 4163) = 4.99, p > .05$. Thus, all factor variances and covariances differed across the sexes except for variance in sensitivity to pathogen disgust and the covariance between sensitivity to pathogen disgust and sensitivity to moral disgust (see Table 4).

Table 4.
Three Domain Disgust Scale factor loadings, variances, and covariances across the sexes

	Pathogen		Sexual		Moral	
	Men	Women	Men	Women	Men	Women
Standing close to a person who has body odor	0.57	0.60				
Shaking hands with a stranger who has sweaty palms	0.64	0.63				
Stepping on dog poop	0.72	0.71				
Accidentally touching a person's bloody cut	0.63	0.60				
Seeing some mold on old leftovers in your refrigerator	0.73	0.73				
Sitting next to someone who has red sores on their arm	0.61	0.54				
Seeing a cockroach run across the floor	0.66	0.63				
Bringing someone you just met back to your room to have sex			0.76	0.73		
Watching a pornographic video			0.72	0.63		
A stranger of the opposite sex rubbing your thigh in an elevator			0.76	0.60		
Having anal sex with someone of the opposite sex			0.63	0.56		
Hearing two strangers having sex			0.78	0.62		
Performing oral sex			0.72	0.46		
Finding out that someone you don't like has sexual fantasies about you			0.72	0.66		
Forging someone's signature on a legal document					0.67	0.66
Intentionally lying during a business transaction					0.76	0.79
Stealing from a neighbor					0.76	0.73
A student cheating to get good grades					0.66	0.71
Shoplifting a candy bar from a convenience store					0.78	0.75
Deceiving a friend					0.68	0.67
Cutting to the front of a line to purchase the last few tickets to a show					0.78	0.77
Pathogen	0.77	0.73				
Sexual	0.55	0.49	2.40	1.92		
Moral	0.43	0.42	0.39	0.35	1.65	1.49

Note: Bolded font indicates lack of invariance across sexes (i.e., sex differences). Intersections between the same TDDS factors are variances; intersections between different TDDS factors are standardized covariances (i.e., correlations).

Discussion

Overall, while not operating identically between the sexes, the TDDS demonstrated acceptable and similar model fit for both men and women. For both sexes, the seven pathogen items measured a single dimension; the seven sexual items measured a single dimension; and the seven moral items measured a single dimension. Differences that did exist – both in statistically significant lack of invariance and magnitude of invariance – largely concerned the sexual disgust factor and items on that factor. That such differences exist should not be surprising in light of the vastly different consequences of sexual behavior for men and women – differences that theoretically lead to the large sex difference in sensitivity to sexual disgust.

Four of the seven sexual disgust items loaded differently for men and women, and each had a lower loading for women. This suggests that, for these items, factors beyond sensitivity to sexual disgust have greater influence on women's responses than men's responses. For example, the item "A stranger of the opposite sex rubbing your thigh in an elevator," loads .76 for men and .60 for women. So while a large amount of the variance in item responses is accounted for by the sexual disgust factor for both sexes (58% for men and 36% for women), it appears that the self-reported disgust response to this item for women is less related to sensitivity to sexual disgust, as measured by the TDDS, than it is for men. This may in part reflect that sensitivity to sexual disgust is more of a heterogeneous construct for women than for men. That is, for men, disgust toward oral sex, unwanted sexual advances, hearing people having sex, and having anal sex strongly relate to an overarching tendency to be disgusted by sexuality. To an extent, women's disgust toward sexuality may be somewhat more compartmentalized – their disgust toward those

individual items have less to do with their overall disgust toward sexuality, and are more influenced by unmodeled factors.

For practical measurement purposes, though, the sexual items appear to be adequately measuring a single factor for both men and women. Rather than suggesting poor measurement properties, these results suggest a new direction for research on sexual disgust that involves sex-specific specificity in attitudes toward sexuality. Also, the sex difference in the loading for the item “Performing oral sex” was conspicuously different than that of the other items (.72 versus .46), and was lower than any other item loading for women. Future revisions of the measure may consider replacing this item. Additionally, although the difference in the magnitude of the internal consistencies was small, these differences could produce artificially higher correlations between sexual disgust and other variables for men.

Although the differences in covariances between the factors were very small, they may also be theoretically informative. Disgust toward sexual concepts and pathogen cues were slightly more related for men than for women, despite the fact that sex puts women at higher infection risk than men. Despite the greater infection costs and risks for women, perhaps disease-avoidance plays a lower proportionate role in women’s motivation to avoid sex. Said another way, even though the absolute costs and risks of disease via sex are greater for women, they may be proportionately lower given the costs women pay for sex with a lower quality or less compatible partner.

Disgust toward lying cheating, and stealing was more strongly related to disgust toward sexual concepts for men than for women. It is possible that, given the costs potentially imposed on women via sex – and men’s role in imposing such costs at their

own benefit – men who are more averse to lying, cheating, and stealing are also more averse to imposing such costs. Of course, as is the case with the sex difference in the relationship between sensitivity to sexual and pathogen disgust, further research need be done to test these hypotheses.

Chapter 9

General Discussion

The three studies presented in this manuscript provide new information on the measurement and construct validity of the TDDS. The first study showed that, of Five Factor Model dimensions, sensitivity to pathogen disgust is negatively related to openness, sensitivity to sexual disgust is negatively related to openness and positively related to agreeableness, and sensitivity to moral disgust is positively related to agreeableness and conscientiousness. The second study showed that only sensitivity to sexual disgust is uniquely related to political ideology, but that disgust expressed toward individuals and ideas of a conflicting ideology – “moral” disgust that is perhaps more common than the generic violations included on the moral factor of the TDDS – relates to sensitivity to moral disgust. The third study suggested that the TDDS has good internal reliability and a good factor structure in a large sample of individuals varying in age and geographic location. With a few exceptions – exceptions that may inform future scale modifications and tests of the nature of disgust toward pathogens, sex, and immorality – the measure operated identically for men and women.

The TDDS was developed by Tybur et al. (2009) with two primary goals in mind: 1) to demonstrate that disgust sensitivity can be divided between pathogen disgust, sexual disgust, and moral disgust, and 2) to demonstrate that disgust sensitivity as measured with the Disgust Scale (Haidt et al., 1994) is best interpreted as sensitivity to pathogen disgust, which can be measured succinctly with a seven-item scale rather than the 32-item DS. However, given that the TDDS is a novel, recently published measure, relatively little is known of its validity. The three studies included in this manuscript were intended

to help fill this gap. The current state of knowledge regarding the three factors on the TDDS is detailed below, as are interpretations of this knowledge and directions of future research within each domain.

Sensitivity to Pathogen Disgust

Sensitivity to pathogen disgust is highly correlated with overall DS scores and with all individual domain scores on the DS-R. Thus, most of the past research conducted on “disgust sensitivity” has largely addressed pathogen disgust. This body of literature has suggested that sensitivity to pathogen disgust is a risk factor for a variety of psychopathologies, including obsessive-compulsive disorder, eating disorders, and blood-injury-injection disorders. Interpreting such findings in light of the disease-avoidance function of pathogen disgust – rather than the symbolic “animal reminder” function suggested by Rozin et al. (2008) – may improve understanding of the risk factors, motivations, and maintenances of such disorders.

In addition to the theoretical function of pathogen disgust discussed in the introduction of this manuscript, individuals who are more sensitive to pathogen disgust are less open to new ideas and experiences, which may involve disease risks (Schaller & Murray, 2008), and perceive themselves as more vulnerable to disease. These converging lines of evidence suggest that variation in sensitivity to pathogen disgust may indeed tap individual differences in motivation to avoid disease risks. In this light, sensitivity to pathogen disgust may even be a superior measure of disease-avoidance concerns relative to Perceived Vulnerability to Disease (PVD; Faulkner et al., 2004), given actual disgust experience may be a more accurate manifestation of disease-avoidance than compulsions

related to avoiding sick people or public telephones, or objective reports of illness frequency (items from the PVD scale).

Sex differences in sensitivity to pathogen disgust are small but reliable. The sex difference found in the large sample in Study 3 ($d = .20$) is similar to those found by Tybur et al. (2009) in the development of the TDDS, and echo sex differences in the DS and in disgust responses to images of insects, soiled diapers, and goop (Curtis et al., 2004). Such sex differences may mirror men's generally more risky life-history strategy, or they may reflect women's suppressed immune function as a necessity of pregnancy.

These findings set a foundation for understanding individual differences in sensitivity to pathogen disgust. However, a very important issue remains unresolved: what causes such variation? Even if it can be assumed that sensitivity to pathogen disgust reflects motivation to avoid infectious disease, it is unclear why some individuals are more motivated than others. Future studies should investigate the development of sensitivity to pathogen disgust. It would be valuable to establish if individuals with weaker immune systems are more disgusted by pathogen cues, and if there is a period in development in which sensitivity to pathogen disgust calibrates to immune function. Instead of (or in addition to) actual immune function, sensitivity to pathogen disgust may vary as a function of exposure to cues for the presence and consequences of infectious disease. For example, seeing conspecifics who appear infected, or being exposed to highly ritualized cleaning behaviors, may lead a person to develop a low threshold to experience disgust when pathogen cues are detected.

Sensitivity to Sexual Disgust

The original DS included four items purported to measure sensitivity to sexual disgust: I think homosexual activities are immoral; I think it is immoral for people to seek sexual pleasure from animals; You hear about an adult woman who has sex with her father; and You hear about a 30 year old man who seeks sexual relationships with 80 year old women. These items were dropped from the DS-R because they covaried weakly with the other DS items (this is consistent with findings by Tybur et al. (2009) that sensitivity to sexual disgust is relatively independent from sensitivity to pathogen disgust). Beyond this four-item DS subscale, which perhaps did not relate strongly to sexual disgust, few have investigated disgust toward sex, and none have investigated individual differences in sensitivity to sexual disgust.

Although the purported animal-reminder theory of sexual disgust is theoretically untenable and is not supported empirically (Tybur et al., 2009), the hypothesis that sexual disgust functions to motivate avoidance of potentially costly sexual behaviors is consistent with the large sex difference found across studies. The results listed in this manuscript – that sensitivity to sexual disgust is negatively related to openness, positively related to agreeableness, and positively related to political conservatism – opens the door for further theoretical developments regarding the nature of sexual disgust and variation in the tendency to be disgusted by sex.

An interesting – and unexplored – aspect of sensitivity to sexual disgust relates to the strong covariation between disgust responses to diverse sexual concepts. For example, disgust toward performing oral sex, which seems to involve no direct reproductive risks, taps the same latent sexual disgust variable as short-term sex and

sexual coercion, which presumably are disgusting largely because of their reproductive risks (e.g., not securing investment, not thoroughly evaluating the partner for quality and compatibility). This suggests that variation in disgust toward sex operates rather generally, further suggesting one of two possibilities. First, it is possible that the different costs of sexual behavior covary, thus leading to covarying disgust responses to behaviors connoting different costs. Second, it is possible that, regardless of the different costs imposed by different sexual behaviors, people tend to act rather globally – they act similarly to pathogen-risky sexual behaviors as they do to pregnancy risky sexual behaviors. Relatedly, some evidence from Study 3 suggests that one (or both) of these two possibilities applies more strongly for men than for women. Given the more varied costs of sexual behavior for women, it is possible that sexual disgust operates less globally for them relative to men.

Future research should address both the development and function of varying degrees of sensitivity to sexual disgust, and its practical implications. Whereas a large body of research has investigated relationships between sensitivity to pathogen disgust and psychopathologies, a bevy of disorders may relate to over or under-active sexual regulation. Contingent on the stability of sensitivity to sexual disgust across the lifespan, low sensitivity may be a risk factor for sexual addiction or risky sexual behavior in the future (and may interplay with perceived vulnerability to disease – and sensitivity to pathogen disgust – Bryan, 1997), and high sensitivity may be a risk factor for a hypoactive sex drive or even conditions such as vaginismus (Miller, 2005). On a practical basis, individuals who are more sensitive to sexual disgust may avoid becoming familiar

with and practicing safe sex, thus, ironically, leading to greater costs of sexual behavior when they do have sex.

Sensitivity to Moral Disgust

Research on moral disgust has advanced significantly in just the past four years. Imaging studies (e.g., Shaich Borg et al., 2008) have demonstrated that moral transgressions related to violence and theft activate similar neural regions as pathogen cues, foul odors have been shown to increase moral judgment (Schall et al., 2008), facial expressions in response to moral disgust elicitors have been shown to be similar to those activated by pathogen cues (Chapman et al., 2009), and the disgust response to moral transgressions has been shown to be present in children at age six (Danovitch & Bloom, 2009). The introduction of a measure of sensitivity to moral disgust – and the demonstration that sensitivity to moral disgust is relatively independent from sensitivity to pathogen and sexual disgust – provides another advancement in this area.

Although some have suggested that “moral” disgust is simply a metaphor used by lay people for rhetorical effect (Bloom, 2004; Nabi, 2002), results presented here and by Tybur et al. (2009) – along with those discussed above – suggest that this is probably not the case. Not only are the physiological responses to disgust elicitors like those used in the TDDS similar to responses to pathogen cues, but the self-reports of disgust responses are internally consistent and demonstrate convergent and discriminant validity in line with predictions made from a functional account of moral disgust.

In addition to a bevy of research that might capitalize on investigating individual differences in moral disgust (e.g., research on altruism, reciprocity, and third-party punishment), this developing literature presents a number of challenges to some popular

existing perspectives on moral disgust. According to the CAD triad hypothesis (Rozin et al., 1999), disgust is, along with anger and contempt, one of three emotions governing moral sanctioning. Under this model, violations of “divinity” (e.g., a person eating a piece of rotten meat; a person touching a corpse) elicit disgust, whereas violations of “autonomy” (e.g., a person cutting in line) elicit anger and violations of “community” (e.g., a 16 year old refusing to give up their seat to an elderly person) elicit contempt. These examples of “divinity” elicitors are clearly related to pathogens, and the moral violations that seem clearly related to disgust based on results from Shaich Borg et al. (2008), Chapman et al. (2009), and Danovitch and Bloom (2009) are categorized as anger and contempt elicitors related to community and autonomy.

The connection between specific emotions and moral violations is complicated, and it may be the case that specific violations (e.g., stealing) do not statically elicit specific emotions (e.g., anger versus disgust). Rather, stealing may elicit anger in some situations (e.g., someone stealing your wallet, or someone stealing from your tip jar) versus disgust in other situations (e.g., someone stealing someone else’s wallet, or someone stealing from someone else’s tip jar). A fruitful research program may investigate the marginal costs and benefits associated with anger and aggression versus disgust and social avoidance – when marginal costs associated with anger and direct confrontation are high, a violation may elicit disgust; when marginal costs associated with anger and direct confrontation are low, a violation may elicit anger.

As with sensitivity to pathogen and sexual disgust, future research on sensitivity to moral disgust should investigate the source of individual differences. From these studies, we know that sensitivity to moral disgust covaries with an individual’s

friendliness and prosociality, and with an individual's conscientiousness. However, sensitivity to moral disgust appears to be relatively independent of political ideology. It would be useful to further examine relations between sensitivity to moral disgust and individuals' investment in groups, and investment in social norms that help maintain groups. Further, it would be useful to investigate how and why individuals vary in their investment in groups.

As is the case with sensitivity to sexual disgust, sensitivity to moral disgust as an individual differences construct could prove useful in a variety of research areas. Disgust toward anti-social behaviors may be an important factor in decisions in economic games, attitudes toward punishment of norm and law-violators, and perhaps even willingness to give benefits to other prosocial individuals.

Summary

Research related to disgust has many applications, partially because of the multiple functions inherent to the emotion. This, in combination with some intrinsic interest in disgust, has led to an explosion of disgust research in the past decade. However, most of this research has been conducted using either no theoretical framework or a theoretical framework seriously lacking in plausibility and empirical support. Further, most empirical work concerning individual differences has been done using a measure with poor reliability and validity.

Misguided theory and measurement has survived partially because few studies rigorously investigated the reliability and validity of the Disgust Scale introduced by Haidt et al. (1994), and still fewer studies interpreted the measure's validity in terms of a theoretically grounded perspective. Research from an alternative, evolutionarily informed

perspective can greatly increase the relevance and accuracy of this booming research area. For this to happen, though, thorough investigations of measures such as the TDDS must first be made. Hopefully, this series of studies progresses the understanding of disgust sensitivity, and provides future researchers with information regarding the reliability and validity of the TDDS.

APPENDIX A: THREE DOMAIN DISGUST SCALE

The following items describe a variety of concepts. Please rate how *disgusting* you find the concepts described in the items, where 0 means that you do not find the concept disgusting at all, and 6 means that you find the concept extremely disgusting.

	not at all disgusting			extremely disgusting			
1. Shoplifting a candy bar from a convenience store	0	1	2	3	4	5	6
2. Hearing two strangers having sex	0	1	2	3	4	5	6
3. Stepping on dog poop	0	1	2	3	4	5	6
4. Stealing from a neighbor	0	1	2	3	4	5	6
5. Performing oral sex	0	1	2	3	4	5	6
6. Sitting next to someone who has red sores on their arm	0	1	2	3	4	5	6
7. A student cheating to get good grades	0	1	2	3	4	5	6
8. Watching a pornographic video	0	1	2	3	4	5	6
9. Shaking hands with a stranger who has sweaty palms	0	1	2	3	4	5	6
10. Deceiving a friend	0	1	2	3	4	5	6
11. Finding out that someone you don't like has sexual fantasies about you	0	1	2	3	4	5	6
12. Seeing some mold on old leftovers in your refrigerator	0	1	2	3	4	5	6
13. Forging someone's signature on a legal document	0	1	2	3	4	5	6
14. Bringing someone you just met back to your room to have sex	0	1	2	3	4	5	6
15. Standing close to a person who has body odor	0	1	2	3	4	5	6
16. Cutting to the front of a line to purchase the last few tickets to a show	0	1	2	3	4	5	6
17. A stranger of the opposite sex intentionally rubbing your thigh in an elevator	0	1	2	3	4	5	6
18. Seeing a cockroach run across the floor	0	1	2	3	4	5	6
19. Intentionally lying during a business transaction	0	1	2	3	4	5	6
20. Having anal sex with someone of the opposite sex	0	1	2	3	4	5	6
21. Accidentally touching a person's bloody cut	0	1	2	3	4	5	6

APPENDIX B: NEO-PI-3

Here are a number of statements that assess personality traits. Please write a number next to each statement to indicate the extent to which you agree or disagree with the statement.

- | | 1 | 2 | 3 | 4 | 5 |
|---------|--|----------------------|-------------------------------|-------------------|-------------------|
| | Disagree
strongly | Disagree
a little | Neither agree
nor disagree | Agree
a little | Agree
strongly |
| ___ 1. | I am not a worrier | | | | |
| ___ 2. | I often get angry at the way people treat me | | | | |
| ___ 3. | I rarely feel lonely or blue | | | | |
| ___ 4. | When I'm around people, I worry that I'll make a fool of myself | | | | |
| ___ 5. | It doesn't bother me too much if I can't get what I want | | | | |
| ___ 6. | I often feel helpless and want someone else to solve my problems | | | | |
| ___ 7. | I really like most people I meet | | | | |
| ___ 8. | I shy away from crowds of people | | | | |
| ___ 9. | I am dominant, forceful, and assertive | | | | |
| ___ 10. | I have a laid-back style in work and play | | | | |
| ___ 11. | I often crave excitement | | | | |
| ___ 12. | I have never literally jumped for joy | | | | |
| ___ 13. | I have a very active imagination | | | | |
| ___ 14. | I'm not really interested in the arts | | | | |
| ___ 15. | Without strong emotions, life would be uninteresting to me | | | | |
| ___ 16. | I'm pretty set in my ways | | | | |
| ___ 17. | I often enjoy playing with theories or abstract ideas | | | | |
| ___ 18. | I believe letting students hear controversial speakers can only confuse and mislead them | | | | |
| ___ 19. | Often, people aren't as nice as they seem to be | | | | |
| ___ 20. | I'm not crafty or sly | | | | |
| ___ 21. | Some people think I'm selfish and egotistical | | | | |
| ___ 22. | I would rather cooperate with others than compete with them | | | | |
| ___ 23. | I don't mind bragging about my talents and accomplishments | | | | |
| ___ 24. | When making laws and social policies we need to think about who might be hurt | | | | |
| ___ 25. | I'm known for my common sense | | | | |
| ___ 26. | I don't mind a little clutter in my room | | | | |
| ___ 27. | I try to perform all the tasks assigned to me conscientiously | | | | |
| ___ 28. | I'm not very ambitious | | | | |
| ___ 29. | I'm pretty good about pacing myself so as to get things done on time | | | | |

- ____ 30. Over the years I've done some pretty stupid things
- ____ 37. I don't get much pleasure from chatting with people
- ____ 38. I like to have a lot of people around me
- ____ 39. Sometimes I don't stand up for my rights like I should
- ____ 40. I act forcefully and energetically
- ____ 41. I wouldn't enjoy vacationing in Las Vegas
- ____ 42. I have felt overpowering joy
- ____ 43. I try to keep all my thoughts directed along realistic lines and avoid flights of fancy
- ____ 44. I am sometimes completely absorbed in music I am listening to
- ____ 45. I rarely experience strong emotions
- ____ 46. I think it's interesting to learn and develop new hobbies
- ____ 47. I find philosophical arguments boring
- ____ 48. I believe that laws and social policies should change to reflect the needs of a changing world
- ____ 49. I believe that most people are basically well-intentioned
- ____ 50. If necessary, I am willing to manipulate people to get what I want
- ____ 51. I try to be courteous to everyone I meet
- ____ 52. I can be sarcastic and cutting when I need to be
- ____ 53. I'd rather not talk about myself and my achievements
- ____ 54. I don't worry much about the homeless
- ____ 55. I sometimes act thoughtlessly
- ____ 56. I keep my belongings neat and clean
- ____ 57. Sometimes I'm not as dependable or reliable as I should be
- ____ 58. I have a clear set of goals and work toward them in an orderly fashion
- ____ 59. I waste a lot of time before settling down to work
- ____ 60. I think things through before coming to a decision
- ____ 61. I rarely feel fearful or anxious
- ____ 62. I am known as hot-blooded and quick-tempered
- ____ 63. I am seldom sad or depressed
- ____ 64. At times I have been so ashamed I just wanted to hide
- ____ 65. I'm always in control of myself
- ____ 66. When I'm under a great deal of stress, sometimes I feel like I'm going to pieces
- ____ 67. I'm known as a warm and friendly person
- ____ 68. I usually prefer to do things alone
- ____ 69. I have often been a leader of groups I have belonged to
- ____ 70. My work is likely to be slow but steady

- ___ 71. I have sometimes done things just for “kicks” or “thrills”
- ___ 72. I am not a cheerful optimist
- ___ 73. I have an active fantasy life
- ___ 74. Watching ballet or modern dance bores me
- ___ 75. How I feel about things is important to me
- ___ 76. I like the old-fashioned methods I’m used to
- ___ 77. I enjoy solving problems or puzzles
- ___ 78. I believe we should look to our religious authorities for decisions on moral issues
- ___ 79. I believe that most people will take advantage of you if you let them
- ___ 80. I couldn’t deceive anyone even if I wanted to
- ___ 81. Some people think of me as cold and calculating
- ___ 82. I hesitate to express my anger even when it’s justified
- ___ 83. I’m better than most people, and I know it
- ___ 84. We can never do too much for the poor and elderly
- ___ 85. I keep myself informed and usually make intelligent decisions
- ___ 86. I’m not a very orderly or methodical person
- ___ 87. I pay my debts promptly and in full
- ___ 88. When I start a self-improvement program, I usually let it slide after a few days
- ___ 89. I am a productive person who always gets the job done
- ___ 90. Occasionally I act first and think later
- ___ 91. I often feel tense and jittery
- ___ 92. I am not considered a touchy or temperamental person
- ___ 93. I have sometimes experienced a deep sense of guilt or sinfulness
- ___ 94. It doesn’t embarrass me too much if people ridicule and tease me
- ___ 95. When I am having my favorite foods, I tend to eat too much
- ___ 96. I keep a cool head in emergencies
- ___ 97. Many people think of me as somewhat cold and distant
- ___ 98. I really feel the need for other people if I am by myself for long
- ___ 99. In meetings, I usually let others do the talking
- ___ 100. I often feel as if I’m bursting with energy
- ___ 101. I tend to avoid movies that are shocking or scary
- ___ 102. Sometimes I bubble with happiness
- ___ 103. I don’t like to waste my time daydreaming
- ___ 104. I am intrigued by the patterns I find in art and nature
- ___ 105. I seldom pay much attention to my feelings of the moment
- ___ 106. I often try new and foreign foods

- ____ 107. I sometimes lose interest when people talk about very abstract, theoretical matters
- ____ 108. Our ideas of right and wrong may not be right for everyone in the world
- ____ 109. I think most of the people I deal with are honest and trust worthy
- ____ 110. Being perfectly honest is a bad way to do business
- ____ 111. I generally try to be thoughtful and considerate
- ____ 112. If I don't like people, I let them know it
- ____ 113. I am not a show-off
- ____ 114. I have no sympathy for beggars
- ____ 115. I often come into situations without being fully prepared
- ____ 116. I like to keep everything in its place so I know just where it is
- ____ 117. Sometimes I cheat when I play solitaire
- ____ 118. I ignore a lot of silly little rules
- ____ 119. I have trouble making myself do what I should
- ____ 120. I always consider the consequences before I take action
- ____ 121. I seldom feel nervous
- ____ 122. I often get disgusted with people I have to deal with
- ____ 123. I tend to blame myself when anything goes wrong
- ____ 124. I often feel that I am not as good as others
- ____ 125. I seldom give in to my impulses
- ____ 126. It's often hard for me to make up my mind
- ____ 127. I really enjoy talking to people
- ____ 128. I prefer jobs that let me work alone without being bothered by people
- ____ 129. Other people often look to me to make decisions
- ____ 130. I'm not as quick and lively as other people
- ____ 131. I like to be where the action is
- ____ 132. I'm not happy-go-lucky
- ____ 133. I enjoy concentrating on a fantasy or daydream and exploring all its possibilities, letting it grow
and develop
- ____ 134. Poetry has little or no effect on me
- ____ 135. I experience a wide range of emotions or feelings
- ____ 136. I prefer to spend my time in familiar surroundings
- ____ 137. I enjoy working on "mind-twister"-type puzzles
- ____ 138. I believe that it's better to stick to your own principles than to be open-minded
- ____ 139. I'm suspicious when someone does something nice for me
- ____ 140. I would hate to be thought of as a hypocrite
- ____ 141. I'm not known for my generosity

- ___ 142. When I've been insulted, I just try to forgive and forget
- ___ 143. I have a very high opinion of myself
- ___ 144. Human need is more important than economics
- ___ 145. I have good judgment
- ___ 146. I never seem to be able to get organized
- ___ 147. When I make a commitment, I can always be counted on to follow through
- ___ 148. I don't feel like I'm driven get ahead
- ___ 149. Once I start a project, I almost always finish it
- ___ 150. I often do things on the spur of the moment
- ___ 151. I often worry about things that might go wrong
- ___ 152. It takes a lot to get me mad
- ___ 153. I have a low opinion of myself
- ___ 154. I feel comfortable in the presence of my bosses or other authorities
- ___ 155. I sometimes eat myself sick
- ___ 156. I can handle myself pretty well in a crisis
- ___ 157. I find it easy to smile and be outgoing with strangers
- ___ 158. I'd rather vacation at a popular beach than an isolated cabin in the woods
- ___ 159. I would rather go my own way than be a leader of others
- ___ 160. I usually seem to be in a hurry
- ___ 161. I love the excitement of roller coasters
- ___ 162. I am a cheerful, high-spirited person
- ___ 163. If I feel my mind starting to drift off into daydreams, I usually get busy and start concentrating on some work or activity instead
- ___ 164. Certain kinds of music have an endless fascination for me
- ___ 165. I seldom notice the moods or feelings that different environments produce
- ___ 166. I believe variety is the spice of life
- ___ 167. I have little interest in speculating on the nature of the universe or the human condition
- ___ 168. I consider myself broad-minded and tolerant of other people's lifestyles
- ___ 169. My first reaction is to trust people
- ___ 170. Sometimes I trick people into doing what I want
- ___ 171. Most people I know like me
- ___ 172. If someone starts a fight, I'm ready to fight back
- ___ 173. I feel that I am no better than others, no matter what their condition
- ___ 174. I believe all human beings are worthy of respect
- ___ 175. I don't seem to be completely successful at anything
- ___ 176. I'm picky about how jobs should be done

- ____ 177. I follow my ethical principles strictly
- ____ 178. I strive to achieve all I can
- ____ 179. When a project gets too difficult, I'm inclined to start a new one
- ____ 180. I rarely make hasty decisions
- ____ 181. I have fewer fears than most people
- ____ 182. At times I have felt bitter and resentful
- ____ 183. Sometimes things look pretty bleak and hopeless to me
- ____ 184. If I have said or done the wrong thing to someone, I can hardly bear to face them again
- ____ 185. Sometimes I do things on impulse that I later regret
- ____ 186. When everything seems to be going wrong, I can still make good decisions
- ____ 187. I have strong emotional attachments to my friends
- ____ 188. Social gatherings are usually boring to me
- ____ 189. In conversations, I tend to do most of the talking
- ____ 190. My life is fast paced
- ____ 191. I like loud music
- ____ 192. I rarely use words like "fantastic!" or "sensational!" to describe my experiences
- ____ 193. As a child I rarely enjoyed games of make believe
- ____ 194. Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement
- ____ 195. I find it easy to empathize—to feel myself what others are feeling
- ____ 196. On a vacation, I prefer going back to a tried and true spot
- ____ 197. I have a lot of intellectual curiosity
- ____ 198. I think that if people don't know what they believe in by the time they're 25, there's something wrong with them
- ____ 199. I tend to assume the best about people
- ____ 200. At times I bully or flatter people into doing what I want them to
- ____ 201. I think of myself as a charitable person
- ____ 202. I'm hard-headed and stubborn
- ____ 203. I would rather praise others than be praised myself
- ____ 204. I have sympathy for others less fortunate than me
- ____ 205. I have many skills
- ____ 206. I'm not compulsive about cleaning
- ____ 207. I try to do jobs carefully, so they won't have to be done again
- ____ 208. I strive for excellence in everything I do
- ____ 209. There are so many little jobs that need to be done that I sometimes just ignore them all
- ____ 210. I plan ahead carefully when I go on a trip

- _____ 211. Frightening thoughts sometimes come into my head
- _____ 212. Even minor annoyances can be frustrating to me
- _____ 213. Too often, when things go wrong, I get discouraged and feel like giving up
- _____ 214. I feel awkward around people
- _____ 215. I am always able to keep my feelings under control
- _____ 216. I'm pretty stable emotionally
- _____ 217. I take a personal interest in the people I work with
- _____ 218. I enjoy parties with lots of people
- _____ 219. I don't find it easy to take charge of a situation
- _____ 220. I am a very active person
- _____ 221. I like being part of the crowd at sporting events
- _____ 222. I laugh easily
- _____ 223. I would have difficulty letting my mind wander without control or guidance
- _____ 224. I enjoy reading poetry that emphasizes feelings and images more than story lines
- _____ 225. Odd things—like certain scents or the names of distant places—can evoke strong moods in me
- _____ 226. I follow the same route when I go someplace
- _____ 227. I have a wide range of intellectual interests
- _____ 228. People should honor traditional values, not question them
- _____ 229. I have a good deal of faith in human nature
- _____ 230. I'm pretty slick when it comes to dealing with people
- _____ 231. I go out of my way to help others if I can
- _____ 232. I sometimes get into arguments
- _____ 233. I'm a superior person
- _____ 234. I would rather be known as "merciful" than as "just"
- _____ 235. I am efficient and effective at my work
- _____ 236. I spend a lot of time looking for things I've misplaced
- _____ 237. I try to go to work or school even when I'm not feeling well
- _____ 238. I'm something of a "workaholic"
- _____ 239. I have a lot of self-discipline
- _____ 240. I think twice before I answer a question

APPENDIX C: POLITICAL IDEOLOGY ITEMS

	strongly disagree						strongly agree							
	0	1	2	3	4	5	6	0	1	2	3	4	5	6
1. I consider myself to be politically liberal	0	1	2	3	4	5	6	0	1	2	3	4	5	6
2. I would say that I am against the death penalty	0	1	2	3	4	5	6	0	1	2	3	4	5	6
3. I think that prayer should be allowed in schools	0	1	2	3	4	5	6	0	1	2	3	4	5	6
4. I think that homosexuals should have the same marriage rights as heterosexuals	0	1	2	3	4	5	6	0	1	2	3	4	5	6
5. I often identify with the policies of the Democratic party	0	1	2	3	4	5	6	0	1	2	3	4	5	6
6. I believe that illegal immigration is one of the biggest problems facing our country	0	1	2	3	4	5	6	0	1	2	3	4	5	6
7. I think that possession of marijuana should be legal in the U.S.	0	1	2	3	4	5	6	0	1	2	3	4	5	6
8. I think that the minimum wage should be raised considerably	0	1	2	3	4	5	6	0	1	2	3	4	5	6
9. I think that people have a moral responsibility to act in environmentally friendly ways	0	1	2	3	4	5	6	0	1	2	3	4	5	6
10. I consider myself to be politically conservative	0	1	2	3	4	5	6	0	1	2	3	4	5	6
11. I think it's important that the government maintain the separation of church and state	0	1	2	3	4	5	6	0	1	2	3	4	5	6
12. I think our gun control laws are too strict	0	1	2	3	4	5	6	0	1	2	3	4	5	6
13. I often identify with the policies of the Republican Party	0	1	2	3	4	5	6	0	1	2	3	4	5	6

APPENDIX D: POLITICAL DISGUST ITEMS

	not at all disgusting			extremely disgusting			
1. Democrats' values	0	1	2	3	4	5	6
2. The 2003 invasion of Iraq	0	1	2	3	4	5	6
3. Abortion in the first trimester of pregnancy	0	1	2	3	4	5	6
4. Tax cuts for the wealthy	0	1	2	3	4	5	6
5. Teaching intelligent design in high school classrooms	0	1	2	3	4	5	6
6. Gay marriage	0	1	2	3	4	5	6
7. Current U.S. President George W. Bush	0	1	2	3	4	5	6
8. Burning the American Flag	0	1	2	3	4	5	6
9. Former U.S. President Bill Clinton	0	1	2	3	4	5	6
10. Republicans' values	0	1	2	3	4	5	6

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