How Disgust Influences Health Purity Attitudes[1]

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Abstract

Food and health regulations are increasingly being pushed onto the political agenda, with rising concerns about genetically modified foods, obesity rates, and vaccination. Public beliefs and attitudes on these issues often conflict with the scientific evidence, yet we know relatively little about what influences opinion on these issues. The public lacks clear partisan cues, and many food and health attitudes cut across the ideological spectrum. We argue that these issues represent new 'purity' attitudes that are driven by the emotion of disgust. Across three studies, both by measuring individuals' trait disgust sensitivity and experimentally inducing an emotional state of disgust, we demonstrate the impact of disgust on food and health policy attitudes. Our results show that greater sensitivity to disgust is associated with support for organic foods, opposition to genetically modified foods, and anti-vaccination beliefs. However, we find only limited evidence that experimentally manipulated disgust affects attitudes toward genetically modified and organic foods. Overall, our results demonstrate that disgust plays an important role in attitudes regarding public health and broadens our understanding of purity attitudes.

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> "We now have proof that virtually every pregnant woman and every fetus is—or soon will be—intoxicated with dangerous chemicals because of genetically engineered foods. Experiments have demonstrated that the effects of GMOs can be catastrophic."
> - Heidi Stevenson, anti-GMO journalist[2]

> "Drug companies are racing to develop vaccines that use human, animal, insect, plant and even cancer cells for production. Living cells can be contaminated with viral DNA that could evolve in humans to make us sick or kill us."
> - Barbara Loe Fisher, anti-vaccination activist[3]

Over the last several years, there have been growing political movements in the United States against foods containing genetically modified organisms (GMOs) and processed foods, and skepticism of the safety of vaccines. These movements hold important implications for public health. For example, although research shows that GMO foods pose no additional threat beyond traditional foods (Nicolia et al. 2014), a large segment of the public is concerned about GMOs and 28 state legislatures considered GMO labeling laws in 2014 alone (NCSL).[4] A national poll conducted by CBS News in January 2013 revealed that 75% of the public was "somewhat" or "very" concerned about genetically modified food.[5]

In another recent trend, increasing rates of philosophical exemptions from child vaccinations have led vaccination rates to fall dangerously low in some areas (Richards et al. 2013). The result has been outbreaks of diseases like whooping cough, measles, mumps, and typhoid – diseases that had previously been contained (Sugerman et al. 2010; Wang et al. 2014).

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[2] Heidi Stevenson, "GMO Toxins in Nearly All Pregnant Women & Fetuses," GreenMedInfo, www.greenmedinfo.com/blog/gmo-toxins-are-nearly-all-pregnant-women-fetuses (accessed June 5, 2014).
[3] Barbara Loe Fisher, "Vaccine Contamination: A Threat to Human Health," *National Vaccine Information Center Newsletter*, www.nvic.org/NVIC-Vaccine-News/May-2010/VACCINE-CONTAMINATION--A-THREAT-TO-HUMAN-HEALTH.aspx (accessed June 1, 2014).
[4] Scott Hendrick, "Vermont's New GMO Labeling Law Faces Challenges," National Conference of State Legislatures Blog. http://www.ncsl.org/blog/2014/05/12/vermont-s-new-gmo-labeling-law-faces-challenges.aspx (accessed December 19, 2014).
[5] CBS News. CBS News/60 Minutes/Vanity Fair Poll: Genetically Modified Food/Sports/Gun Control. 1st Roper Center for Public Opinion Research version. Lincoln, NE: Gallup Organization [producer], 2000. Storrs, CT: The Roper Center, University of Connecticut [distributor], 2013.

Overall, these health policy issues have been increasing in salience and may have important impacts on public health, both positive and negative.

In spite of the rising importance of these attitudes, we have little knowledge of their source. Common ideological explanations contribute little, as liberals and conservatives alike share these attitudes. For example, according to a June 2012 poll conducted by CBS/NYT, 37% of liberals and 39% of conservatives report being "very concerned" with genetically modified foods, showing no evidence of ideological polarization. Similarly, a 2011 poll conducted by CBS shows that 13% of liberals and 17% of conservatives agree that parents are "smart" to avoid vaccinating their children. Health concerns play a major role in anti-GMO and anti-vaccination attitudes (Costa-Font, Gil, and Traill 2008; Hausman et al. 2014; Smith et al. 2011), yet we know relatively little about the source of these concerns.

We propose that many food and health policy attitudes are best understood as purity attitudes, which serve to protect the body and soul from contamination, and are driven by the emotion of disgust (Horberg et al. 2009). Across three studies, we find that individuals who are dispositionally more sensitive to disgust are more likely to hold food and health purity attitudes, such as support for labeling and banning genetically modified foods, banning chemical pesticides, growth hormones, and antibiotics, and skepticism of the safety and efficacy of vaccines. We also show some evidence that experimentally induced feelings of disgust increase support for health purity attitudes, particularly those relating to food. Overall, our results demonstrate the importance of the emotion of disgust for explaining a critical set of attitudes towards public health and government regulation. Additionally, the evidence suggests that we ought to broaden notions of purity attitudes beyond sexual issues to include the topics of food and health.

State and Trait Emotions in Political Research

Emotions have a substantial impact on political attitudes (e.g., Banks and Valentino 2012; Hatemi et al. 2013) and behaviors (e.g., Brader, Valentino, and Suhay 2008; Brader 2005; Marcus et al. 2000; Panagopoulos 2011; Valentino et al. 2011), and help to solve collective action problems in political participation (Groenendyk 2011; Valentino et al. 2008). A growing body of research in political science and psychology demonstrates that discrete emotions, such as anger, fear, and anxiety, have distinct effects on political outcomes. For example, anxiety causes increased political information search (Gadarian and Albertson 2014; Valentino et al. 2009). Fear motivates conservative foreign policy attitudes (Gadarian 2010) and negative attitudes towards out-groups (Hatemi et al. 2013), while sadness and anger cause higher and lower support for welfare, respectively (Petersen 2010; Petersen et al. 2012; Small and Lerner 2008). Anger also motivates political action (Ryan 2012) and punitive attitudes (Gault and Sabini 2000). In spite of the growing recognition of the importance of discrete emotions for explaining political phenomena, we know less about the role of the emotion of disgust in politics (for discussion, see Hatemi and McDermott 2012).

Disgust is often studied as a transitory emotional state ("state" disgust), but there are dispositional differences in how readily and intensely individuals experience disgust in response to a potential disgust elicitor ("trait" disgust). In this sense, disgust sensitivity is not a measure of the experience of disgust, but an individual difference in the tendency to experience disgust in response to potential elicitors. Similarly, personality research demonstrates that individual, stable differences in the Big Five personality traits help explain patterns of political behavior, and they do so particularly by showing that variation in personality traits predicts different reactions to the same situations (e.g., Mondak 2010, Mondak et al. 2010, Gerber et al. 2011). Political scientists

have begun examining similar dispositional differences in trait-based emotions such as fear and anxiety (Cassese and Hannagan 2014; Hatemi et al. 2013) and recent work argues that disgust sensitivity underlies socially conservative attitudes (e.g., Hibbing et al. 2014; Inbar et al. 2011; Inbar et al. 2009; Smith et al. 2011). However, political scientists have yet to examine how state and trait-based disgust might influence attitudes towards issues at the theoretical core of disgust – those involving food and personal health.

Disgust and the Behavioral Immune System

Disgust has rapidly gained attention from psychologists, some of whom place it at the "center of several critical questions about human culture and cognition" (Strohminger 2014, 478). Disgust is characterized by many as part of a 'behavioral immune system' that motivates avoidance of people or situations that might result in contamination, such as the consumption of toxins, physical contact with an ill person, or any action that involves puncturing or breaking the skin (Neuberg, Kenrick, and Schaller 2011; Schaller and Park 2011), as well as the expulsion of potential toxins from the body (Toronchuk and Ellis 2007). In a cross-cultural study of hygiene, Curtis and Biran (2001) review a list of the main infectious diseases of modern humans, and find that only a single disease out of more than 50 was not directly connected to a disgust elicitor. Thus, disgust is theorized to protect the body from contamination through common disease vectors—primarily food, sex, and interpersonal contact (e.g., Haidt, McCauley, and Rozin 1994).[6]

[6] Some hold that disgust has its origins in oral rejection of bitter substances (which may be poisonous), but was then co-opted as a disease avoidance mechanism (Chapman et al. 2009; Rozin, Haidt, and Fincher 2009), while another line of literature views pathogen disgust as having its origins rooted more directly in pathogen avoidance (Tybur et al. 2013).

According to this evolutionary perspective of disease avoidance, disgust should be especially subject to false alarms and difficult to inhibit (Oaten et al. 2009; Russell and Giner-Sorolla 2010). When it comes to potentially fatal contaminants, it is better to have a sensitivity bias. For example, while disgust sensitivity has been linked to fear of spiders, which may pose a contamination threat, it is also associated with a phobia towards injections and invasive medical procedures (e.g., Sawchuk et al. 2000). As a demonstration of the difficulty of overriding contamination cues, Rozin et al. (1986) showed that subjects were reluctant to eat a piece of chocolate shaped like dog poop or drink juice that has been in contact with a sterilized cockroach, even when informed they were perfectly safe. Related research finds that the highly disgust sensitive are more likely to associate physical disability with disease, leading to stigmatization (Park et al. 2007). Studies such as these demonstrate that disease and contamination cues can have powerful impacts on attitudes and behaviors and are difficult to cognitively override.

Fitting with the pathogen avoidance perspective, there has been considerable research evaluating the effects of trait-based disgust sensitivity or state-based feelings of disgust on sexual attitudes. Disgust has been characterized as "guarding the purity of the body and soul" (Haidt et al. 1994, 704), forming the basis of the moral foundation of purity/sanctity (Haidt and Graham 2007; Horberg et al. 2009). As such, disgust sensitivity predicts a wide variety of conservative attitudes towards sex, which arguably reduce the likelihood of contracting disease. Disgust sensitivity predicts harsher moral judgments of premarital sex and homosexuality (Smith et al. 2011), opposition to gay marriage (Inbar et al. 2009; Terrizzi et al. 2010), more negative attitudes towards homosexuals (Inbar et al. 2009), and conservative sexual attitudes more generally (Olatunji 2008). Similarly, studies show inducing an emotional state of disgust causes

more negative attitudes towards homosexuals (Inbar, Pizarro, and Bloom 2012; Terrizzi, Shook, and Ventis 2010).[7] Disgust sensitivity even plays a role in related policy attitudes that are more distantly connected to sexual intercourse, such as opposition to abortion (Inbar, Pizarro, and Bloom 2009; Terrizzi, Shook, and Ventis 2010) and stem cell research (Terrizzi et al. 2010).

Trait and state disgust have also been linked to in-group preferences and territorial attitudes (Navarrete and Fessler 2006). According to an evolutionary view of disgust, foreigners may pose a contamination threat by carrying novel pathogens to which people have not yet adapted. Following this logic, several studies have connected disgust to negative attitudes towards outsider groups. Disgust sensitivity and disease reminders predict distrust and negative attitudes towards foreigners generally (Faulkner et al. 2004; Navarrete and Fessler 2006) and priming disgust enhances the effects of old-fashioned racism on racial policy attitudes (Banks and Valentino 2012). Disgust sensitivity and perceived vulnerability to disease also predict prejudicial attitudes against individuals with physical disabilities (Park et al. 2003) and obese people (Lieberman et al. 2012; Park et al. 2007). Bolstering the external validity and evolutionary logic behind this work, cross-cultural research has also demonstrated that infectious disease prevalence is associated with decreased sociability across societies, including lower levels of extraversion and openness to experience (Schaller and Murray 2008), higher levels of collectivism (Cashdan and Steele 2013), and stronger family ties and religiosity (Fincher et al. 2008).

Overall, existing research provides support that disgust constitutes an important part of the behavioral immune system, leading to conservative attitudes on issues related to sex and out-groups. Psychologists have also found a positive relationship between political conservatism and

[7] While Inbar et al. (2012a) find a main effect for state disgust on prejudicial attitudes towards gay men, Terrizzi et al. (2010) find that state disgust increases prejudice towards homosexuals among political conservatives, but *decreases* prejudice among liberals.

disgust sensitivity (Inbar et al. 2011; Inbar et al. 2009; Smith et al. 2011; Terrizzi et al. 2013; Terrizzi et al. 2010), though the magnitude of the relationship varies depending on how ideology and disgust sensitivity are measured (for an alternative view of ideology and disgust, see Tybur et al. 2010). In combination with work on fear and negativity bias, this research has led some to argue that disgust sensitivity may be one of the fundamental psychological dispositions underlying political ideology, particularly the social dimension of conservatism (Hibbing, Smith, and Alford 2014; Oxley et al. 2008; Smith et al. 2011).

While there is growing evidence that disgust facilitates conservative attitudes towards out-groups and sex, little research has examined the role of disgust in a less ideological, but key domain of the behavioral immune system—public policies related to food and health. Indeed, early work described disgust as a "food-related emotion," defining it as "revulsion at the prospect of oral incorporation of offensive objects" (Rozin and Fallon 1987, 23). A related line of research demonstrates that people have a bias for 'natural' products, believing them to be healthier, even when chemically identical to alternative products (Rozin 2005; Rozin et al. 2004). Among the variety of foods studied by Rozin (2005), genetically modified foods were perceived as the least natural, and perceptions of naturalness strongly predict attitudes towards GMOs (Tenbült et al. 2005). These concerns are often reflected in the rhetoric around GMOs and organic foods, with activists making references to toxic chemicals, "poisonous" ingredients, or genetically modified "frankenfood." Similarly, opponents of vaccination worry that vaccines contain toxic chemicals, such as thimerosal, that may be harmful (Hausman et al. 2014). This rhetoric bears a striking similarity to language used in the stem cell debate (another policy area in which opposition is driven by disgust; Terrizi et al. 2010), which also made references to Frankenstein and used words like "gruesome" and "grotesque" (Nisbet et al. 2003). Finally,

existing literature ties disgust to attitudes towards obesity, smoking and drug use, all of which involve the consumption of potential contaminants. Drug addicts, smokers, and the obese all elicit disgust, though these feelings might stem from attributions of control (Vartanian 2010).

Based on existing literature, we expect pathogen disgust sensitivity to motivate support for food and health regulations in an attempt to protect oneself from contamination and disease. Individuals high in pathogen disgust should be more attentive to potential contaminants (Charash and McKay 2002), more likely to categorize new objects as potential contaminants, and more likely to remember these objects (Miller and Maner 2012).[8] In short, trait emotions, such as disgust sensitivity, affect how one "selects into and experiences specific environments" (Hatemi et al. 2013, 281). As a result, we expect individuals high in pathogen disgust to hold more health purity attitudes, such as supporting banning genetically modified foods and the use of chemical pesticides (H1). Similarly, experimentally induced feelings of state disgust should heighten sensitivity to potential contaminants, increasing support for food and health regulations (H2). Finally, we expect that the effects of state disgust will be strongest among those high in pathogen disgust sensitivity (H3). This is because individuals high in disgust sensitivity will experience stronger feelings of state disgust and they are more likely to have already made a connection between GMOs, for example, and potential contaminants (for a related argument, see Cassese and Hannagan 2014). In sum, pathogen disgust sensitivity should bias attention and memory towards potential contaminants, while manipulated state disgust should enhance these effects.

Data and Methods

We conducted three studies to test our hypotheses. Study 1 was conducted on 210 subjects from Amazon's Mechanical Turk (MTurk) during the summer of 2013. Study 2

[8] For a related argument regarding trait fear, see Hatemi et al (2013).

examined attitudes among 174 students enrolled in political science courses at a private university in the south during the fall semester of 2013 and spring semester of 2014. Study 3 consisted of a panel study of 400 subjects from MTurk during the spring of 2014, 311 of whom completed both waves.[9] Although none of our samples are nationally representative, MTurk provides a diverse sample that is more attentive than common subject pools (Hauser and Schwarz 2015) and has been shown to replicate experiments from nationally representative samples (Berinsky, Huber, and Lenz 2012; Weinberg, Freese, and McElhattan 2014). Moreover, finding similar results across different samples strengthens the generalizability of our claims. Table 1 shows the demographics of our three samples. As is typical of student and MTurk samples, our subjects lean politically liberal, and tend to be young and educated. All three samples have a roughly equal balance of men and women. The MTurk samples skew towards the low end of the income distribution, while our student sample is much wealthier.

[9] The attrition rate is only 22%, which compares favorably to other panels conducted on Mechanical Turk (c.f. Ahler 2014).

Table 1. Sample Characteristics

	Study 1 (Mturk)	Study 2 (Student)	Study 3 (Mturk)
Ideology			
Liberal	43.9%	53.1%	61.0%
Moderate	36.8%	18.4%	18.5%
Conservative	19.3%	28.5%	20.5%
Education			
HS or less	10.9%	NA	16.0%
Some college	46.0%		37.5%
Bachelor's	43.1%		46.5%
Income			
Less than $30,000	NA	8.6%	35.30%
$30,000-50,000		4.6%	26.30%
$50,000-75,000		6.3%	19.80%
$75,000-100,000		9.1%	11.30%
$100,000-150,000		13.7%	6.30%
$150,000-250,000		16.0%	1.30%
$250,000-500,000		23.4%	NA
More than $500,000		18.3%	NA
Male	49.8%	43.2%	59.8%
Age (Mean)	34.0	NA	29.7
Complete Cases	211	170	400

NA = Not asked. Study 1 used a branching measure of ideology while the others did not. The student sample comes from a private university in the southeastern United States. Mturk samples were limited to the U.S.

Measures

To test our first hypothesis regarding individual differences in disgust sensitivity, we rely on the Three Domains of Disgust (TDDS) framework, which provides an evolutionary account of three factors of disgust sensitivity (Tybur et al. 2009). The TDDS measure includes three subscales corresponding with pathogen, sexual, and moral disgust. Of greatest relevance to our research is the pathogen disgust subscale, which is conceptualized as "a first line of defense that

functions as a 'behavioral immune system' preventing contact with and ingestion of pathogens" (Tybur et al. 2009, 105).[10] Indeed, psychologists argue that the pathogen disgust subscale is the best available measure of the behavioral immune system (Tybur et al. 2014), and that pathogen disgust and the behavioral immune system are conceptually identical (Lieberman and Patrick 2014).[11] We measured pathogen disgust sensitivity from the Three Domains of Disgust Scale (Olatunji et al. 2012; Tybur et al. 2009) in all three studies. Additionally, the first wave of Study 3 measured the full TDDS scale, including the sexual and moral disgust subscales.

To test our second and third hypotheses, we manipulated state disgust at the beginning of Study 1 and the beginning of the second wave of Study 3. In Study 1, state disgust was manipulated using an autobiographical writing task, which is commonly used for manipulating emotions such as disgust (e.g., Lerner and Keltner, 2001; Schnall et al. 2008).[12] In Study 3, we chose to manipulate disgust by showing respondents disgust-eliciting pictures (e.g., Lee, Sohn, and Fowler 2013; Schnall et al. 2008).[13] To provide a cover story, subjects were asked to imagine touching the object in the picture, then to rate the object on a variety of adjectives, such as soft, slimy, sticky, and rough. Subjects in the control condition rated eight neutral pictures, such as sand or wood. Subjects in the treatment condition rated four of these same neutral pictures and four disgusting pictures, such as feces, a rash, and a dirty toilet (see Appendix for details). We chose this particular task because MTurk workers are often asked to categorize

[10] Sexual disgust is theorized to motivate the avoidance of sexual partners and behaviors that could endanger long-term reproductive success, while moral disgust motivates the avoidance of social norm violators (Tybur, Lieberman, and Griskevicius 2009).

[11] Although many researchers have relied on the Disgust Scale (Rozin et al. 1999) or Disgust Scale-Revised (Olatunji et al. 2007), these scales are not ideal for measuring the behavioral immune system (Tybur, Frankenhuis, and Pollet 2014).

[12] Subjects were randomly assigned to treatment (n = 118) and control (n = 97) conditions using Qualtrics survey software.

[13] Subjects were randomly assigned to treatment (n = 157) and control (n = 156) conditions using Qualtrics.

words and images, creating a plausible cover story and forcing subjects to engage with the images.

Throughout the three studies, we relied on similar outcome measures, with only minor variations. Full question wording and scale reliabilities are shown in the Online Appendix, but we briefly review our measures here. Attitudes towards GMOs were measured with two items assessing support for banning GMO crops and livestock and one item regarding mandatory labeling of foods containing GMOs. Support for organics was measured with three items assessing support for banning chemical pesticides and the use of livestock hormones, and tax breaks for organic farmers. Perceived risks were measured with five items asking respondents to assess the risk to "human health, safety or prosperity" of artificial sweeteners, high fructose corn syrup, GMOs, water fluoridation, and MSG (Kahan et al. 2012). Food regulation was measured with a single item regarding favorability of increased government regulation of food safety. Environmental regulation was measured with two items assessing support for increased regulation of air and water quality. Prospective behavior was measured with three items assessing the likelihood of shopping at natural foods stores, buying organics and buying GMOs (reversed) in the next two weeks.

Vaccination attitudes were measured with up to seven items on the safety and efficacy of vaccines. Attitudes towards obesity policies were measured with up to seven items, such as support for junk food taxes, soda bans, and mandatory calorie information. Support for a smoking ban in bars and restaurants was measured with a single item. Finally, drug attitudes were measured with three items assessing support for legalizing marijuana for medical and recreational purposes and decriminalizing all drug use.

Analysis

Below, we predict each outcome variable as a function of demographic controls and political ideology (for a similar approach, see Smith et al. 2011). Models for outcomes in Study 3 also include controls for sexual and moral disgust. Although most outcomes are modeled using OLS, in some cases (noted below) highly skewed dependent variables led us to use ordered logit models. In order to gauge effect sizes, we report standardized regression coefficients and odds ratios, as appropriate. Because we have directional predictions, we report one-tailed tests of our hypotheses, unless otherwise noted.[14] For manipulations of state disgust, results from t-tests are displayed at the bottom of each table, though we also control for the disgust treatment in each model. Results from the t-tests and models largely converge, with the exception of one case, which is noted below. We begin by examining the main effects of disgust sensitivity (H1) and state disgust (H2), and investigate interactions between state and trait disgust (H3) in a separate section below.

State Disgust Manipulation Checks

In Study 1, a t-test shows that the disgust manipulation significantly increased state disgust, as self-reported at the end of the survey, $t(210) = 3.60$, $p < .001$, $d = .50$, but did not significantly affect other emotions, such as anger, fear, or enthusiasm. We also examined whether the treatment had larger effects among those higher in disgust sensitivity. However, in a regression predicting state disgust as a function of the treatment, disgust sensitivity, and an interaction, the interaction term was not statistically significant ($b = -.001$, $p = .997$). We also find no evidence that the manipulation at the beginning of the survey affected responses to the disgust sensitivity scale measured late in the survey $t(210) = -.56$, $p = .58$, $d = .08$.[15]

[14] We use two-tailed p-values for control variables, as we do not have directional predictions for the coefficients.
[15] We also find no evidence that the treatment affected the distribution of disgust sensitivity, as the variance was indistinguishable across conditions ($SD_{control} = .78$, $SD_{treat} = .73$, $p = .53$).

Similarly, in Study 3, a t-test shows that the treatment increased state disgust, $t(311) = 7.15$, $p < .001$, $d = .81$. In contrast to Study 1, we did find evidence of a positive interaction between the treatment and pathogen disgust sensitivity when predicting state disgust ($b = .94$, $p = .004$). However, we found no such interaction between the treatment and moral disgust ($b = .30$, $p = .31$) or sexual disgust ($b = -.36$, $p = .26$), indicating that our treatment specifically targeted pathogen disgust. This finding also suggests that writing and image manipulations may produce different results, an issue that we return to below.

Genetically Modified and Organic Foods

We begin with the outcomes for which we have the strongest predictions – genetically modified foods and organic foods. Results are shown in Table 2. Disgust sensitivity strongly predicts attitudes towards GMOs in Study 1 ($b = .13$, $t(201) = 1.91$, $p = .029$), Study 2 ($b = .17$, $t(168) = 2.31$, $p = .011$), and Study 3 ($b = .24$, $t(300) = 2.78$, $p = .003$). Disgust sensitivity also predicted support for organic foods in Study 1 ($b = .17$, $t(204) = 2.49$, $p = .007$), Study 2 ($b = .25$, $t(168) = 3.47$, $p < .001$), and Study 3 ($b = .17$, $t(300) = 1.90$, $p = .029$). Overall, we find strong evidence across all three studies that pathogen disgust sensitivity increases support for natural and organic foods, and motivates opposition to GMOs.

We find weaker evidence on these outcomes for state disgust, however. In Study 1, t-tests show the state disgust manipulation led to greater opposition to GMOs, $t(211) = 1.60$, $p = .055$, $d = .22$, and greater support for organic food, $t(210) = 1.56$, $p = .060$, $d = .22$, though both fall short of conventional levels of statistical significance. In Study 3, the state disgust manipulation had no discernible effects on either GMOs ($t(311) = .02$, $p = .494$, $d = .002$) or organics ($t(311) = .70$, $p = .241$, $d = .08$).

We find no evidence that the state disgust manipulation influenced prospective purchasing of natural and organic foods, $t(210) = .14$, $p = .44$, $d = .02$, nor did disgust sensitivity, $b = .03$, $t(204) = .43$, $p = .33$.[16] It may be that purchasing behavior is highly constrained by cost and availability (Vermeir and Verbeke 2006), and indeed, some of our subjects commented that they were unable to avoid purchasing GMOs. In Study 2, disgust sensitivity also did not affect the index of perceptions of risk from high fructose corn syrup, fluoridated water, GMOs, artificial sweeteners, and MSG ($b = .07$, $t(169) = .95$, $p = .17$). Given the consistent findings above for GMOs, we examined this item independently from the rest of the index. As expected, disgust sensitivity significantly predicts perceived risk of GMOs ($b = .25$, $OR = 1.28$, $p = .047$).[17] Thus, while we find no evidence that disgust motivates risk perceptions for these new outcomes, we find evidence consistent with our other findings regarding GMOs.

Next, we examined whether disgust influences support for greater government regulation of food, more generally, as well as the air and water. In Study 2, disgust sensitivity predicts support for greater government regulation of food, $b = .14$, $t(168) = 1.85$, $p = .033$. In Study 3, food regulation is highly skewed in favor of support so we use an ordered logit model. Again, we find that disgust sensitivity predicts greater support ($b = .23$, $p = .008$, $OR = 1.26$).[18] Disgust sensitivity also predicted support for increased government regulation of the air and water in Study 2, $b = .17$, $t(168) = 2.26$, $p = .013$. In Study 3, 42% take the top score on this

[16] We find evidence that the three items making up the purchasing index do not scale well ($\alpha = .51$), largely due to the reversed item. However, our results are substantively unchanged by analyzing each item independently.
[17] We use an ordered logit model here because our dependent variable only has five categories.
[18] We find substantively similar results when using an OLS model.

Table 2. Disgust and Food Attitudes

Outcome:	GMOs			Organics			Purchasing	Risk	Food Regulation		Environ. Regulation	
Study, Sample:	1, Mturk	2, Students	3W2, Mturk	1, Mturk	2, Students	3W2, Mturk	1, Mturk	2, Student	2, Student	3W1, Mturk	2, Student	3W1, Mturk
Model:	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	Ord. Logit	OLS	Ord. Logit
Pathogen Disgust	**0.13 ***	**0.17 ****	**0.17 ****	**0.17 ****	**0.25 *****	**0.12 ***	**0.03**	**0.08**	**0.13 ***	**1.31 ****	**0.16 ***	**1.15**
	(.07)	**(.07)**	**(.06)**	**(.07)**	**(.07)**	**(.06)**	**(.06)**	**(.08)**	**(.08)**	**(.15)**	**(.07)**	**(.13)**
Disgust Treatment	**0.22**	**-**	**0.02**	**0.22 ***	**-**	**0.11**	**0.02**	**-**	**-**	**-**	**-**	**-**
	(.14)		**(.10)**	**(.13)**		**(.10)**	**(.12)**					
Sexual Disgust			0.09			0.05				0.77 *		0.87
			(.07)			(.07)				(.10)		(.11)
Moral Disgust			-0.03			-0.06				1.08		1.10
			(.06)			(.06)				(.12)		(.12)
Ideology	-0.04	-0.12	-0.16 **	-0.18 **	-0.15 *	-0.09	-0.04	-0.03	-0.32 ***	0.66 ***	-0.36 ***	0.53 ***
	(.07)	(.07)	(.06)	0.06	(.07)	(.05)	(.06)	(.08)	(.07)	(.07)	(.07)	(.06)
Education	-0.05		-0.09 *	-0.01	-	-0.02	0.02			0.972		1.02
	0.07		(.05)	0.07		(.05)	(.06)			(.09)		(.10)
Male	-0.22	-0.64 ***	-0.49 ***	-0.46 **	-0.45 **	-0.70 ***	-0.11	-0.33 *	-0.11	0.56 **	-0.04	0.71
	0.14	(.15)	(.12)	0.13	(.15)	(.12)	(.12)	(.16)	(.15)	(.13)	(.15)	(.16)
Age	0.1		0.07	0.04		0.09	-0.02			1.073		1.13
	(.07)		(.06)	(.06)		(.06)	(.06)			(.11)		(.11)
Income		0.04	0.03		-0.01	-0.03		-0.02	0.11	0.95	-0.05	0.91
		(.07)	(.05)		(.07)	(.05)		(.08)	(.07)	(.09)	(.07)	(.09)
Constant	-0.01	0.26 **	0.29 **	0.12	0.18	0.37 ***	3.03 ***	0.16	0.03		0.02	
	(.12)	(.09)	(.10)	(.12)	(.10)	(.10)	(.11)	(.10)	(.10)		(.10)	
Observations	211	170	310	211	170	310	211	171	170	400	170	400
R-squared	0.07	0.18	0.19	0.16	0.17	0.20	0.01	0.04	0.13	0.03	0.15	0.04
Treatment Effect	0.22	-	0.00	0.21	-	0.08	0.02	-	-	-	-	-
Standard error	(.14)		(.06)	(.14)		(.11)	(.14)					
p - value	0.06		0.49	0.06		0.24	0.44					

Standard errors in parentheses. * p < .05. Significance tests are one-tailed for tests of our hypotheses (bold) and two-tailed for control variables because we do not have directional expectations. The lower panel shows treatment effects of the disgust manipulation using a t-test.

index, so we predict it with an ordered logit model.[19] The effect is in the expected direction, but not statistically significant (b = .16, OR = 1.17, p = .074). In sum, we find strong evidence that disgust sensitivity predicts support for food regulation, and some evidence that it motivates regulation of the air and water as well.

Overall, we find strong evidence that disgust sensitivity predicts support for restrictive policies designed to maintain food purity. Disgust sensitivity also predicted support for regulation of the air and water, two environmental issues with connections to disgust. We find some suggestive evidence that state disgust has similar effects on attitudes towards GMOs and organics, though only in Study 1. We return to this disparity below. As for other predictors, we only find two consistent patterns. First, conservatives tend to be less supportive of organic food and less opposed to GMOs, though these effects tend to be of equal or smaller magnitude than the effects of disgust sensitivity. However, ideology was a much stronger predictor for outcomes on which the ideological implications were made clear in the question wording, such as increased government regulation of food, air, and water. Finally, gender was consistently a strong predictor, with women being much more supportive of organic food and more opposed to GMOs. We discuss the role of gender in more detail below.

Vaccinations

Next we turn to the topic of vaccine skepticism (results shown in Table 3). In our student sample (Study 2), disgust sensitivity predicted greater skepticism of vaccines, but was not statistically significant, b = .11, t(168) = 1.40, p = .083. In the first wave of Study 3 (MTurk), an ordered logit model reveals that pathogen disgust sensitivity is associated with greater belief that vaccines cause autism (b = .29, OR = 1.34, p = .006,). In the second wave of Study 3, pathogen disgust sensitivity also predicted skepticism of the safety and efficacy of vaccines, b = .22, t(300)

[19] Results are substantively similar when using an OLS or tobit model.

= 3.45, p = .001. However, state disgust did not significantly affect vaccine skepticism in Study 3, $t(311)$ = .44, p = .331, d = .05. Overall, we find strong support in our MTurk sample that disgust sensitivity motivates vaccine skepticism. We did not find evidence in our student sample, which may be because it is a less salient issue among undergraduates. Few other variables significantly predict vaccine skepticism, though conservatives are significantly more skeptical in Study 3, and moral disgust predicts lower levels of vaccination, perhaps reflecting the perception of vaccination as a societal obligation.

Table 3. Disgust and Vaccine Skepticism

Outcome:	Vaccinations		
Study, Sample:	2, Student	3W1, Mturk	3W2, Mturk
Model:	OLS	Ord. Logit	OLS
Pathogen Disgust	**0.11**	**1.34 ****	**0.22 *****
	(.08)	**(.16)**	**(.06)**
Disgust Treatment	**-**	**-**	**0.04**
			(.11)
Sexual Disgust		1.32 *	0.08
		(.17)	(.07)
Moral Disgust		0.78 *	-0.21 ***
		(.08)	(.06)
Ideology	0.07	1.55 ***	0.24 ***
	(.08)	(.16)	(.06)
Education		0.99	-0.05
		(.10)	(.06)
Male	-0.40 *	1.45	0.08
	(.16)	(.34)	(.13)
Age		1.10	0.03
		(.11)	(.06)
Income	-0.04	0.99	-0.03
	(.07)	(.10)	(.05)
Constant	0.17		-0.06
	(.10)		(.10)
Observations	170	400	310
R-squared	0.07	0.04	0.14
Treatment Effect	-	-	0.05
Standard error			(.11)
p - value			0.33

Standard errors in parentheses. * p < .05. Significance tests are one-tailed for tests of our hypotheses (bold) and two-tailed for control variables because we do not have directional expectations. The lower panel displays treatment effects of the disgust manipulation using a t-test.

Obesity, Smoking, and Illegal Drugs

Lastly, we turn to a class of policies regarding regulation of harmful substances, including junk food, cigarettes, and illegal drugs. Smokers, drug users, and the obese are often viewed as having high personal control over their behavior, leading to negative attitudes and

emotions (Barry et al. 2009; Brownell 1991; Vartanian 2010). As a result, attitudes on these topics may be a different class of risks with different antecedents (Slovic, Fischhoff, and Lichtenstein 1982). Starting with obesity issues, disgust sensitivity predicted greater support for regulating junk food in Study 1, $b = .12$, $t(204) = 1.68$, $p = .048$, but fell short of statistical significance in Study 2, $b = .10$, $t(169) = 1.32$, $p = .095$. In Study 1, state disgust had the expected effect, but fell short of statistical significance, $t(210) = 1.41$, $p = .080$, $d = .19$, however, upon controlling for covariates, this effect becomes statistically significant, $b = .24$, $t(204) = 1.80$, $p = .037$. Thus, we find only modest evidence that disgust plays a role in attitudes towards regulation of junk food.

Turning to cigarette laws, we did find the expected effect for disgust sensitivity in Study 1 ($b = .14$, $t(204) = 1.95$, $p = .027$), but not in Study 3 ($b = .02$, $p = .412$, $OR = 1.02$). In Study 2, disgust sensitivity predicted greater support for drug laws, $b = .16$, $t(169) = 2.19$, $p = .015$. Surprisingly, in Study 3 we do not find that pathogen disgust sensitivity predicts drug laws ($b = -.02$, $t(391) = -.21$, $p = .917$), but we do find evidence that sexual disgust predicts support for drug laws ($b = .42$, $t(391) = 5{,}83$, $p < .001$).[20] State disgust did not affect attitudes towards cigarettes in Study 1 ($t(210) = .54$, $p = .706$, $d = .07$) or Study 3 ($t(311) = 1.35$, $p = .91$, $d = .15$). Nor did state disgust affect drug law attitudes in Study 3, $t(311) = 1.15$, $p = .87$, $d = .13$. Overall, we find only weak evidence that disgust sensitivity motivates restrictive smoking and drug laws and no evidence that state disgust influences these attitudes.

[20] This finding is consistent with Kurzban et al. (2010), who argue that opposition to drug use is motivated by a committed reproductive strategy, which is associated with sexual, rather than pathogen disgust.

Table 4. Disgust and Health Attitudes Involving Personal Responsibility

Outcome:	Obesity		Drug Laws			Cigarette Restrictions		
Study, Sample:	1, Mturk	2, Students	2, Students	3W1, Mturk	3W2, Mturk	1, Mturk	3W1, Mturk	3W2, Mturk
Model:	OLS	OLS	OLS	OLS	OLS	OLS	ologit	ologit
Pathogen Disgust	**0.12 ***	**0.10**	**0.16 ***	**-0.02**	**0.05**	**0.14 ***	**1.03**	**1.14**
	(.07)	**(.08)**	**(.07)**	**(.09)**	**(.06)**	**(.07)**	**(.11)**	**(.15)**
Disgust Treatment	**0.24 ***	**-**	**-**	**-**	**-0.12**	**-0.10**	**-**	**0.71**
	(.13)				**(.10)**	**(.14)**		**(.16)**
Sexual Disgust				0.59 ***	0.30 ***		0.97	1.02
				(.10)	(.07)		(.12)	(.15)
Moral Disgust				-0.10	-0.11 *		1.06	1.15
				(.09)	(.05)		(.11)	(.15)
Ideology	-0.25 ***	-0.23 **	0.33 ***	0.44 ***	0.35 ***	-0.11	0.83 *	0.88
	(.07)	(.07)	(.07)	(.08)	(.05)	0.07	(.08)	(.10)
Education	-0.05	-	-	0.01	0.01	0.18 *	1.28 **	1.21 *
	(.07)			(.08)	(.05)	(.07)	(.12)	(.14)
Male	-0.08	-0.20	-0.37 *	-0.11	0.00	-0.11	0.52 **	0.49 *
	(.14)	(.16)	(.15)	(.18)	(.05)	(.14)	(.12)	(.13)
Age	-0.08	-	-	0.12	0.06	0.00	1.03	1.11
	(.07)			(.08)	(.05)	(.07)	(.10)	(.13)
Income	-	0.01	0.03	0.07	0.00	-	1.21 *	1.35 *
		(.07)	(.07)	(.08)	(.05)		(.12)	(.15)
Constant	-0.09	0.08	0.13	3.70 ***	0.05	0.11	-	-
	(.12)	(.10)	(.09)	(.13)	(.09)	(.13)		
Observations	211	171	171	400	310	211	400	310
R-squared	0.11	0.08	0.18	0.25	0.29	0.07	0.02	0.03
Treatment Effect	0.19	-	-	-	-0.13	-0.08	-	0.15
Standard error	(.14)				(.11)	(.14)		(.11)
p - value	0.08				0.87	0.71		0.91

Standard errors in parentheses. * p < .05. Significance tests are one-tailed for tests of our hypotheses (bold) and two-tailed for control variables because we do not have directional expectations. The lower panel displays treatment effects of the disgust manipulation using a t-test.

Does Disgust Sensitivity Moderate Treatment Effects?

According to our third hypothesis, the effects of state disgust should be larger among individuals higher in pathogen disgust sensitivity. To test this expectation, we re-estimated the relevant models above while including an interaction term between the disgust manipulation and pathogen disgust sensitivity. Results are shown in Table A1 in the appendix, with marginal treatment effects at high and low levels of disgust sensitivity displayed in the bottom panel. Starting with Study 1, in each of the five cases the interaction term is in the expected direction, with the treatment having a larger effect among the disgust sensitive, but in no case is the interaction term statistically significant. Turning to Study 3, the interaction term is in the expected direction in four of five cases, and statistically significant in three cases (GMOs, organic foods, and smoking bans). However, in these three instances, although the treatment effect is always positive among individuals high in disgust sensitivity, it is only statistically significant in the case of organic foods. Thus, the interaction effects seem to be partially driven by an unexpected backlash effect in which individuals low in disgust sensitivity became *less* supportive of regulation (though this effect is statistically significant only in the case of cigarette regulations).

Overall, we find only suggestive evidence for our third hypothesis—that state disgust will have a larger effect among those high in disgust sensitivity, particularly for food outcomes. Interestingly, we found a stronger pattern in Study 3, which utilized an image manipulation, though also some evidence of backlash among those low in disgust sensitivity. Thus, it may be that the image manipulation was more obtrusive, leading to differential effects, though we can only speculate on this point.

Are the Effects of Disgust Stronger Among Women?

Gender differences in disgust have been well-established, with women scoring higher across all of the domains of disgust, and sexual disgust in particular (Tybur et al. 2011). Yet, even after controlling for disgust sensitivity, we found that gender was often a strong predictor of support for health regulations, particularly those involving food. A variety of evidence suggests not only gender differences in these attitudes, but also gender differences in how disgust affects these attitudes. For example, women are more concerned with their weight (Tiggemann and Rothblum 1988), and pathogen disgust predicts negative attitudes towards obese people among women, but not men (Lieberman, Tybur, and Latner 2012). Women also tend to be more involved in household food purchases (Belch and Willis 2002; Rasmussen et al. 2006) and are less likely to smoke (Warren et al. 2006). Another line of literature finds gender differences in self-reported disgust sensitivity, but not physiological measures (Smith et al. 2011), and some suggest this is a result of men underreporting disgust (Balzer and Jacobs 2011). However, we take the position of Smith et al. (2011, 5) that self-report and physiological measures of disgust sensitivity "are two valid but very different approaches to measurement." Moreover, recent work utilizing multiple samples and methods demonstrates that the TDDS scale has similar measurement properties among men and women (Tybur et al. 2011). Thus, there is reason to believe that gender may moderate the effects of disgust, though this is unlikely to be driven by differential measurement error.

To investigate whether disgust operates differently among men and women, we re-estimated all of the previous models while including interaction terms between gender and state and trait disgust. Details are shown in the Online Appendix (Table A2), but out of 33 tests, we

find a significant interaction term in only 4 cases. Three of these cases come from Study 3, in which we observe an interaction between gender and the disgust treatment in predicting attitudes towards GMOs, organics, and cigarette restrictions. In Study 2, we observe a significant interaction between gender and disgust sensitivity in predicting regulation of air and water. In each of the cases, the interaction is in the expected direction, with disgust having a larger impact among women than among men. Thus, we find some evidence for a moderating effect of gender, but given the sporadic results and the large number of tests, disgust does not seem to have consistently different effects for men and women in the domains we investigate here.

Conclusion

Across three studies, we find evidence that the emotion of disgust operates as part of the behavioral immune system, influencing policy attitudes on a variety of topics related to health. Our strongest evidence comes from attitudes related to genetically modified and organic foods. In all three studies we find disgust sensitivity affects these attitudes. People high in pathogen disgust sensitivity were more likely to support mandatory labeling of GMOs, as well as outright bans on GMOs, chemical pesticides, and the use of hormones and antibiotics on livestock. Disgust sensitivity also predicted greater support of food regulation generally, motivating a broader role for the government in regulating health. However, we found weaker evidence that disgust motivates attitudes on issues relating to personal responsibility, such as restrictions on drugs, cigarettes, and junk food. Overall, these results suggest that emerging issues related to health policy, particularly those involving natural food, share a common motivational thread of maintaining one's health in the face of potential contaminants.

Our findings cohere with a broad literature on disgust sensitivity as part of a behavioral immune system, but suggest broadening notions of purity politics. Purity has been identified as one of five moral foundations concerned with protecting the sanctity of the body and soul (Graham, Haidt, and Nosek 2009; Haidt and Graham 2007), and appears to be driven by disgust (e.g., Horberg et al. 2009). Both disgust and the purity foundation have been found to drive a variety of socially conservative attitudes, such as opposition to stem cell research, gay marriage, and stem cell research (e.g., Koleva et al. 2012; Terrizzi, Shook, and Ventis 2010). Much of this research focuses on sexual aspects of disgust, yet our results demonstrate the importance of also studying pathogen disgust, a separate dimension of disgust that is central to the behavioral immune system. In contrast to sexual disgust, pathogen disgust sensitivity motivates a variety of food and health attitudes that have not been strongly politicized and are held across the ideological spectrum. Many of these issues are relatively new on the political agenda, and their antecedents in disgust may help propel them to the status of a moral issue (Horberg et al. 2009; Mäkiniemi, et al. 2012; Rozin 1999; Rozin et al. 1997). Following these issues as they develop will help sort out the relationships between disgust and political ideology (Hibbing et al. 2014; Oxley et al. 2008; Smith et al. 2011), as well as deepen our understanding of moralization processes (Horberg et al. 2009).

With regards to vaccination attitudes, disgust sensitivity had a strong impact on anti-vaccination beliefs and attitudes among our adult samples. People who are more sensitive to disgust were more likely to believe that vaccines cause autism, and were more skeptical of the efficacy and safety of vaccines. However, this pattern was weak and not statistically significant in our student sample, perhaps because the issue is less salient to students. Given the difficulty of cognitively overriding disgust (Russell and Giner-Sorolla 2010), our findings may shed some

light onto the difficulty of correcting misperceptions about vaccination (Nyhan and Reifler 2014; Nyhan et al. 2014), but further research is needed on the topic.

Our findings were less supportive for state disgust. We uncovered suggestive evidence that our disgust manipulation affected food attitudes in Study 1, and some evidence that it affected food attitudes among those high in disgust sensitivity in Study 3. These findings on state disgust contrast with the strong evidence we found for disgust sensitivity on these outcomes. Our examination of disgust sensitivity tells us more about how individuals select into different environments and interpret information, thus giving us an idea of the long-term impact of this individual difference on attitude formation. In contrast, the efficacy of disgust primes that are not directly connected to the outcome measures may be reliant on previous exposure to information and claims about the topics. Had we chosen to manipulate disgust in a way that is tied to the outcome measure (e.g., showing disgusting pictures of genetically modified animals), we might have observed stronger effects (e.g., Gadarian and Albertson 2014; Gadarian 2010).

These findings also raise an interesting methodological question about manipulating state disgust. We manipulated disgust using a writing induction task in Study 1 and an image task in Study 3, and these studies produced results that diverged in two important ways. First, in Study 3, pathogen disgust sensitivity (but not sexual or moral) moderated the impact of the manipulation on self-reported feelings of disgust. However, there was no similar evidence of moderation in Study 1. Thus, it may be that writing induction tasks are more effective at inducing disgust among all types of subjects. Second, we found some evidence of the hypothesized interaction between the disgust manipulation and disgust sensitivity in affecting our outcome measures in Study 3. In Study 1, though, we found no evidence of such an interaction, which may be because the writing induction was more effective at inducing disgust

among all subjects. These results emphasize that further work is needed to sort out how to best manipulate emotions, and how different manipulations might produce different results (Searles and Mattes 2015).

The future of public opinion on these health purity issues is uncertain and may depend heavily on how advocacy groups frame these issues in the coming years. On one hand, advocates may be unlikely to directly appeal to disgust, as disgust motivations tend to be less accessible than other emotional motivations, and as a result these motivations are less likely to be communicated (Russell and Giner-Sorolla 2011). This may lead political actors to rely instead rationalize their disgust-based attitudes in terms of alternative motivations, such as harm-avoidance (Clifford and Jerit 2013). A focus on harm, particularly to the environment, may serve to create a more liberal basis of support (Feinberg and Willer 2013). On the other hand, advocates may find strategic methods for eliciting disgust in their audience. For example, slippery slope arguments against gay marriage that rely on comparisons to incest may be effective through their invocation of a stronger disgust-eliciting behavior. In the health domain, claiming the presence of "toxic chemicals" in vaccines or GMOs may be an effective way to induce disgust in the listener. Whether interest groups choose to frame their causes in terms of purity or alternative motivations could have important implications for the ideological makeup of supporters and the political future of these issues (Clifford et al. n.d.; Feinberg and Willer 2013).

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