

# What lies beneath? Fear vs. disgust as affective predictors of absolutist opposition to genetically modified food and other new technologies

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## Abstract

In line with earlier research, a multi-phase study found a significant positive association between a widely used measure of trait disgust and people's tendency to favor absolutist (non-consequentialist) restrictions on genetically modified food (GMF). However, a more nuanced high-granularity approach showed that it was individual sensitivity to fear (specifically, a tendency to feel *creeped out* by strange and subtly deviant events) rather than a tendency to be *disgusted* (orally inhibited) by these events that was a unique predictor of absolutist opposition to GMF and other types of new technology. This finding is consistent with prior theorizing and research demonstrating fear to be “the major determiner of public perception and acceptance of risk for a wide range of hazards” related to new technology (e.g., nuclear power) (Slovic & Peters, 2006, p. 322). The present study calls attention to the importance of conducting future assessments of *disgust* (and other affective constructs) in a manner that, among other things, recognizes the substantial disconnect between theoretical and lay meanings of the term and illustrates how a policy-guiding result may arise from a sheer miscommunication between a researcher and a subject.

Keywords: GMO, disgust, fear, technology, moral

## 1 Introduction

In spite of the wide-ranging scientific consensus that genetically modified organisms have a potential to yield significant economic benefits for the world's least well-off while posing no meaningful risks to the natural environment and human health, genetically modified foods (GMFs) continue to be a topic of controversy and debate both within the Member States of the European Union (EU) and around the globe (European Commission, 2010; Blancke Van Breusegem, De Jaeger, Braeckman & Van Montagu, 2015). While public opposition is especially pronounced within the EU, the anti-GMO movement has been steadily gaining speed within the U.S. (compare Blizzard, 2003 with Funk, 2015), with most contemporary Americans (57 percent) viewing GMFs as “generally unsafe” to eat (Funk, 2015) (see also Bain & Dandachi, 2014 for some recent legislative initiatives favoring the anti-GMF contingent).

Some scholars recently proposed that continued opposition to GMF is affectively based (e.g., Blancke et al., 2015), with several studies documenting a robust link be-

tween GMF and *fear* (Cox & Evans, 2008; Kahan, 2016; Laros & Steenkamp, 2004; Rzymiski & Królczyk, 2016; Ventura, Frisio, Ferrazzi & Siletti, 2016). For instance, Cox and Evans (2008) found that people's general neophobia (anxiety towards novel entities and events) was correlated with their negativity and concerns regarding “novel food technologies” (p. 704), including GMF. Similarly, Kahan's (Kahan, 2016) recent results (based on a nationally representative sample of about 1200) suggest that people's concerns over GMFs were significantly correlated with a variety of “random-ass risk concerns measured by the Scaredy-cat scale” (the scale measuring a propensity to feel threatened by an eclectic set of dangers, ranging from armed car-jackings to drownings of children in swimming pools). These proposals echo prior psychological research arguing that opposition to other forms of new technology (e.g., nuclear power; Fischhoff, Slovic, Lichtenstein, Read & Combs, 1978) has “its roots in ‘gut reactions’ (strong fear) and the construal of this technology as ‘new’” (Sjoberg, 2000, p. 353; see Slovic & Peters, 2006 for an overview). Further studies of public opposition to the construction of nuclear power plants (van der Pligt, Eiser & Spears, 1986) revealed that a perceived potential for unknown yet catastrophic risks was a major source of the fear.

Pertinently, a recent on-line survey (McAnrew & Koehnke, 2016) highlights the importance of differentiating between fear as a response to a definite or fully realized threat (e.g., an armed assailant causing an urge to flee) and fear associated with the mere potential for a threat (e.g., a strangely-dressed individual eyeing you intently from the shadows), with the latter commonly conveyed by the slang expression “creeped out”. In their analysis of the phenomenon,

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McAndrew & Koehnke (2016) found that contra-normative behavior (disregard for social rules) and appearance, e.g., shabby dress and poor hygiene, were common triggers of “creepiness”, with “creepy” individuals’ behaviors being associated with higher-than-neutral ratings of unpredictability or uncertainty.<sup>1</sup> This has important theoretical implications: to the extent that the fear of unknown or opaque risks has been said to lie “at the heart of public opposition” to GMO (Hossein et al., 2002, p. 8; see also Nelson, 2001) — just as it appears to lie at the heart of public opposition to other forms of new technology — individual variation in propensity to feel *creeped out* would appear to be a logical candidate for the affective disposition underlying the public’s opposition to GMF.

However, an important recent report (Scott et al., 2016) concludes that widespread opposition to GMF may in fact be rooted in *disgust*. Most intriguingly, Scott and colleagues have found that within a representative U.S. sample of on-line participants, individuals higher in trait disgust (as gauged by the 25-item Disgust Scale-Revised [DS-R] [Olatunji et al., 2007]) were significantly more inclined toward “absolutist” (strongly non-consequentialist) opposition to GMF, being more likely to endorse a binary statement that GMF ought to be proscribed “no matter how great the benefits and minor the risks from allowing it” (Scott et al., 2016, p. 317, based on Baron & Spranca, 1997). (Also of major importance is Scott et al.’s [2016] result that more than 70 percent of on-line GMF opponents appeared to be opposed to it for “absolutist” reasons, i.e., “regardless of consequentialist considerations” [p. 317]).

Here we contend that, while Scott et al.’s (2016) findings are generative and noteworthy, their interpretability is seriously constrained by the well-established disconnect between theoretical and lay meanings of *disgust* (the term heavily utilized, alongside similarly non-specific “bothered” and “upset”, in DS-R, the disgust measure that they used) (e.g., Nabi, 2002; Royzman & Sabini, 2001; Royzman, Leeman & Sabini, 2008). “Theoretically, *disgust* refers to the offence taken to noxious objects or ideas that evoke. . . nausea” (Nabi, 2002, p. 695) or feeling physically revolted “at the prospect of oral incorporation” (Rozin and Fallon, 1987, p. 23; Angyal, 1941; Olatunji & Sawchuk, 2005; Rozin, Haidt & McCauley, 2008; see also Darwin, 1872/1965); as noted by Rozin et al. (2008), disgust is a category of food rejection (p. 759), with most definitions of disgust “focus[ing] on the mouth and real or imagined ingestion” (Rozin et al., 2008, p. 758). On the other hand, its “common usage . . . appears to reflect that which is not only repellent but also irritating or annoying” (Nabi, 2002, p. 695) (Kayyal, Pochedly, McCarthy & Russell, 2015; Royzman & Sabini, 2001). Accordingly, the lexical definition of disgust describes it as

“a strong feeling of dislike, finding a thing very unpleasant, or against one’s principles” (Ehrlich et al., 1980) and two recent studies (Kayyal et al., 2015; Landy & Piazza, 2016) found that reports of disgust, fear, irritation, and general distress were highly inter-correlated (see also Royzman, Leeman & Sabini, 2008), lending credence to the concern that (at least on-line) participants are using the term (“disgust”/“disgusted”) in a *low-granularity* manner (Lindquist & Barrett, 2008), i.e., as an expression of unspecified aversion or “dislike” (Kayyal et al., 2015, p. 8; see also Royzman & Sabini, 2001). (For present purposes, *granularity* refers to the degree to which a given affective descriptor represents a discreet and qualitatively unique experience, [with e.g., “I have a gagging sensation” being inherently more granular than “This bothers me”], thus expediting more clear communication between a researcher and a subject.)

It is of particular concern that, in spite of a substantial body of work testifying to the prevalence of food neophobia in humans (Pliner & Hobden, 1992) and classic studies linking opposition to new technology with fear, Scott et al. (2016) did not explicitly assess fear. The only relevant affective construct explicitly assessed in addition to trait disgust was trait *anger*, a bona fide *approach* emotion, making disgust the only representative of its (avoidance-related) class. (Given that negative feelings do co-occur and given that having disgust, even if granularly assessed, as the only response option might have caused it to be used as a stand-in for other kinds of negative affect, it would be imperative that future variants of a trait disgust scale feature a menu of non-disgust options including fear and normative disapproval). Considering these complications, it remains unclear which affective sensitivities (fear vs. disgust vs. normative disapproval), if any, are genuinely at work when people oppose GMF.

Another methodological concern stems from Scott et al.’s decision to assess trait disgust and GMF-related absolutism in the course of a single 15-minute session (S. Scott, personal communication, January 27, 2017), with temporally contiguous GMF-related queries/scenarios and disgust items being likely to tip off participants about the study’s overarching intent — establishing a positive association between the extent of one’s opposition to GMF and the signature food-related aversion that is disgust. At the very least, these considerations raise a reasonable concern that, due to some combination of demand characteristics and a deliberate effort to keep one’s responses consistent across items, Scott et al.’s data provide a somewhat inflated estimate of the disgust-GMF link. The validity of these concerns is further underscored by several past studies (e.g., Fessler, Arguello, Mekdara & Macias, 2003; Royzman, Leeman & Baron, 2009; see also Royzman, Kim & Leeman, 2015) that found no significant association between *disgust sensitivity* (DS) and *socio-moral evaluations* when special design features (time delay, misdirection) were in place to make it appear that the measures of morality and disgust were not conceptually aligned.

<sup>1</sup>Intriguingly, the list of creepiest “ratings of occupations” (p. 12) was topped by the (ostensibly unpredictable) clowns, but also featured clergy and taxi drivers.

A further methodological concern stems from Scott et al.'s (2016) claim of a special relationship between trait (or state) disgust and opposition to GMF qua a purity-based prohibition (Scott et al., 2016, p. 316; Haidt, 2012). However, given that GMF was the only new technology assessed in the study, this claim is hard to accept. It seems that, at a minimum, Scott et al. (2016) would have wanted to demonstrate that the predictive powers of DS may extend to other new technologies associated with purity-based concerns (e.g., stem cell research) while *not* extending to new technologies in general, especially those (e.g., nuclear power) with historic ties to fear and no apparent ties to food production.<sup>2</sup> More generally, the claim of a special association between purity and disgust has been greatly problematized by two recent reviews (Cameron, Lindquist & Gray, 2015; Landy & Goodwin, 2015). Having carefully analyzed all the available data, Cameron, et al. (2015) found no specific association between disgust and "purity violations". Similarly, Landy and Goodwin's (2015) recent meta-analysis of the effects of incidental (experimentally induced) disgust on moral cognition found that the effects of incidental disgust on purity-based transgressions were no greater than its effects on harm/rights-based transgressions (indeed, there was a slight trend favoring the latter).

To forestall these various concerns, we used the 7-item pathogen sub-scale (TDDS-P) (a component of Tybur, Lieberman and Griskevicius's [2009] widely used Three Domains of Disgust Scale [TDDS]), a measure highly correlated with and conceptually derived from the DS-R (Tybur et al., 2009, used by Scott et al.). Though originally designed to gauge pathogen-linked disgust, a recent study (Landy & Piazza, 2016) indicates that, due to the multi-faceted nature of its vignettes (e.g., someone emitting foul odor in public could be alternatively construed as gross, creepy, pitiful, or rude), the TDDS-P elicits a wide range of negative reactions beyond disgust. Capitalizing on this and other properties of the scale, we used a time-delay design (see Royzman, Leeman & Baron, 2009) in which the standard ("how disgusting?") administration of the scale was counterbalanced (at the 3 weeks interval) with a higher-granularity alternative, where the affective reactions to each item were explored with far greater specificity and depth.<sup>3</sup> Subsequently (3 weeks later),

the same subjects completed a purportedly unrelated survey containing measures of socio-political attitudes, including three items gauging their preference for absolutist restrictions on GMF, nuclear power, and embryonic stem cells.<sup>4</sup> The design was most directly inspired by our 2008 (Royzman et al., 2008) report on disgust as a potential affective response to sibling incest. Across two studies, Royzman et al. (2008, Study 1) asked subjects to rate their responses to this type of vignette on a variety of scales, including the traditional low-granularity measure of disgust ("how disgusted are you?"), the three-part high-granularity measure of disgust as an oral inhibition response (gagging, loss of appetite, nausea) (see below), a measure of tactile inhibition (unwillingness to touch), a high granularity measure of anger/disapproval, as well as (Study 2) a separate rating of fear. The present study could be viewed as an extension of this 2008 approach to the trait-level analysis.

## 2 Methods

**Subjects.** A total of 141 University of Pennsylvania undergraduates took part in the study in exchange for extra credit. We removed any subject who did not complete all three data collection rounds, anyone who did not fully complete one of the surveys, or anyone who was simultaneously exposed to both the low- and high-granularity conditions in error. All statistical analyses were conducted on the remaining 130 subjects (76 female) (retention rate 92.2 percent). The sample encompassed a wide range of ethnic and national backgrounds, with almost 40 percent of the sample reporting a country of origin other than the U.S. (see Appendix C for details).

**Materials and procedure.** To manage reactivity concerns (see Royzman, Leeman & Baron, 2009), the main dataset was collected in three rounds, comprised of 3 on-line surveys, followed by a supplementary paper-and-pencil survey (see below). In Round 1, each student was randomly assigned to either the standard (based on Tybur et al., 2009) or high-granularity (see below) administration of TDDS-P. In Round 2 (three weeks later), each subject was "re-assigned"

<sup>2</sup>For the sake of completeness, we note that Scott et al. (2016) also examined their subjects' opposition to dolphin-killing. However, given that GMF and dolphin-killing differ in a multitude of ways, one would be hard-pressed to see this as the optimal point of contrast. For one, killing dolphins is not a form of new technology. Second, it poses no perceived threat to one's survival (or health) (in the manner that GMF, nuclear power, or airplane travel could). Third, in terms of sheer severity (Gray & Schein, 2016), fostering new (and potentially risky) forms of food production is no match for killing some of the most lovable creatures on the planet (indeed about 5 times as many subjects accepted GMF as dolphin-killing).

<sup>3</sup>In addition to being partly a true-false measure (and, thus, not lending itself easily to the high-granularity variation, where all questions were framed in terms of feeling intensity) and containing a series of items (e.g., a person walking through a cemetery) that have been argued (Tybur et al.,

2009) to be more closely related to fear than disgust, the 25-item DS-R employed by Scott et al. (2016) would have been difficult to implement in the present case due to its sheer length. Crossing 25 DR-R items with 12 high-granularity ratings (see below) would have resulted in a total of 300 separate questions for the high-granularity condition of the study (see Discussion for more).

<sup>4</sup>It is worth noting that, as our research was not primarily designed as a replication of Scott et al. (2016) — our interest in the topic, i.e., the putative link between trait disgust and "purity"-based opposition to new technology, predates our familiarity with their work — we did not and could not aspire to address all elements of their design. This includes the question of whether the prospect of personally consuming or contemplating someone else's consumption of a genetically modified food could make one genuinely disgusted.

to the complementary condition of the survey, with those initially exposed to the high-granularity administration being asked to compete the standard/low-granularity variant and vice versa. It was stated that the goal of “the two-part” study (referencing Rounds 1 and 2) was to explore certain “psychometric properties of two versions of a commonly used measure of affective responding.” Three weeks following Round 2, subjects received the ostensibly unrelated “socio-political attitudes survey”, which assessed their attitudes toward GMF and two other new technologies with no ties to food production (stem cells and nuclear power). It also included multiple additional measures discussed below, fortifying the impression that the study was “about” political and social attitudes in general.

One week later, a randomly selected subset of subjects ( $N = 42$ ) received a supplementary “word meaning check” survey (see Appendix A for details) designed to ascertain that the subjects’ understanding of the term “creeped out” matched the relevant understanding of the authors’ (fear associated with uncertainty of threat) (per McAndrew & Koehnke [2016]). The data indicated that it did. In line with McAndrew and Koehnke (2016), subjects tended to associate “feeling creeped out” with “nervousness/unease” regarding a *potential* threat, but not with certain danger or disgust, thus clearly conceptualizing “creeped out” as a special member of the fear family.

**Rounds 1 and 2 (Affective Measures).** The standard administration of TDDS-P was modeled after Tybur et al. (2009), with the subjects being asked to rate “how disgusting” they found seven pathogen-linked events (e.g., “Standing close to a person who has body odor”) on a 7-point scale (0=not disgusting at all/6=extremely disgusting). Verbatim low-granularity instructions were as follows: “Please rate how *disgusting* you find the concepts described in the items (e.g. **Stepping on dog poop**), where **0** means that *you did not find the concept disgusting at all* and **6** means that *you found the concept disgusting to an extreme degree*.”

The seven scenarios we used were as follows (see Appendix B for further information regarding counterbalancing):

- \_\_\_ Accidentally touching a person’s bloody cut.
- \_\_\_ Seeing a cockroach run across the floor.
- \_\_\_ Seeing some mold on old leftovers in your refrigerator.
- \_\_\_ Shaking hands with a stranger who has sweaty palms.
- \_\_\_ Sitting next to someone who has red sores on their arm.
- \_\_\_ Standing close to a person who has body odor.
- \_\_\_ Stepping on dog poop.

In the high-granularity variant of the scale, subjects rated the same seven vignettes, indicating in each case how much it made them feel specific sensations or desires on a scale from 0 (not at all) to 6 (extremely). Verbatim high-granularity instructions were as follows: “The following items describe

a variety of concepts. Please rate the extent to which each concept (e.g. **Stepping on dog poop**) makes you feel certain sensations and desires (e.g., feeling creeped out, feeling physically nauseated, wanting to run away, wanting to tell someone off) where **0** means that *you did not experience a given sensation/desire at all* and **6** means that *you experienced it to an extreme degree*. You will do this for seven different concepts.” Rating scales (with scales and scenarios counterbalanced as described in Appendix B) were as follows:

*Oral inhibition (OI):*

[Stepping on dog poop] makes me feel physically nauseated  
[ . . . ] makes me gag  
[ . . . ] makes me lose my appetite

*Disapprove:*

[ . . . ] makes me want to tell someone off  
[ . . . ] makes me want to disapprove of someone  
[ . . . ] makes me want to reprimand someone

*Epidermal discomfort (ED):*

[ . . . ] makes me feel a crawling sensation on my skin  
[ . . . ] makes me want to shake something off me

*Creeped out:*

[ . . . ] makes me feel creeped out

*Run away:*

[ . . . ] makes me want to run away

*Other:*

[ . . . ] makes me feel like crying  
[ . . . ] makes me feel happy

As indicated above, we obtained a total of **12** high-granularity ratings for each vignette (both scenarios and measures were randomized). The ratings included a three item-measure of *Oral inhibition* or *OI* (nausea, gagging, loss of appetite) (e.g., Royzman et al., 2008), a construct logically derived from the theoretical meaning of disgust as a category of food rejection (Angyal, 1941; Darwin, 1872/1965; Nabi, 2002; Olatunji & Sawchuk, 2005; Royzman et al., 2008; Rozin and Fallon, 1987; Rozin et al., 2008; Yoder, Widen, & Russell, 2016; see also an extended discussion of this point in Royzman & Sabini, 2001).<sup>5</sup> In keeping with disgust’s stipulated adaptive origins (Rozin & Fallon, 1987; Royzman & Sabini, 2001; Tybur et al., 2009), the three components of *OI* (nausea, gagging, loss of appetite) have their functional

<sup>5</sup>Consistent with this operationalization, Darwin (1872/1965) described the facial attributes of “extreme disgust” as “expressed by movements round the mouth identical with those preparatory to the act of vomiting” (p. 257) and the facial expression shown to do the best job of differentiating disgust from other affective states (including anger) is known as the “sick face” (raised lower eyelid, raised cheeks, raised upper lip, and jaw drop) produced by asking a professional actress to convey to her audience that she was feeling sick and was about to vomit (Widen, Pochedly, Pieloch & Russell, 2013).

counterparts in the (a) regurgitation of content from the gut, (b) ejection of content from the mouth, and (c) avoidance of any further incorporation into the mouth, respectively. Also included was a two-item measure of *Epidermal Discomfort (ED)* (a crawling sensation on one’s skin, desire to shake something off) designed to capture a set of responses that are psychologically divergent from disgust (Blake, Yih, Zhao, Sung & Harmon-Jones, 2016), but appear to share its key function of pathogen avoidance.

To gauge fearfulness or sensitivity to threat, subjects were asked to report the extent to which each of the seven TDDS-P scenarios made them “feel creeped out” (*Creeped out*) and “want[ing] to run away” (*Run away*) (see the Supplementary Survey in Appendix A and McAndrew & Koehnke [2016] for the validation of “creeped out” as a fear-like state).

Finally, our 12-item assessment procedure encompassed a three-item measure of Normative Disapproval (Disapproval) (*feel like disapproving of someone/something, want to reprimand someone, want to tell someone off*) (see Royzman [2014] for the argument that most instantiations of pathogen-linked disgust are normatively suffused; see Voiklis, Cusimano, and Malle [2014] for the derivation of the items), as well as one-item measures of *sadness (Cry)* and *happiness (Happy)*.

**Round/Survey 3 (Socio-Political attitudes).** To enhance sensitivity, absolutist opposition to new technology was assessed on a continuous scale by asking subjects to report their level of agreement (0 = Strongly disagree and 5 = Strongly agree) with statements advocating restrictions on genetically modified food, as well as nuclear power, and stem cell research “no matter how great [its] [their] benefits or minor [its] [their] risks” (Baron & Spranca, 1997; Scott et al., 2016)<sup>6</sup> (see Aktas, Yilmaz & Bahcekapili, in press, for one recent demonstration that categorical and continuous measures of moral orientation, including those of deontology/consequentialism, perform similarly in relation to other variables of interest). Subjects also completed the 6-item *Purity* and *Fairness* scales from the *Moral Foundations Questionnaire (MFQ-Purity* and *MFQ-Fairness*, respectively) (Graham, Haidt & Nosek, 2009), the 6-item measure of *Traditionalism (TRAD)* from the Authoritarianism-Conservatism-Traditionalism scale (Duckitt, Bizumic, Krauss & Heled, 2010), and the 4-item short *Social Dominance Orientation (SDO)* (Pratto, Sidanius, Stallworth & Malle, 1994) as well as two separate indices of *Social (SocCon)* and *Economic*

<sup>6</sup>It is worth observing that, in our view, all three items are best understood as gauges of strong opinions (italicized) regarding the inherent dangers of GMF, with those thinking that GMFs ought to be regulated “no matter what” representing one end of the spectrum and those thinking otherwise representing the other, with the further understanding that expressed unconditional restrictions are likely unreflective generalizations that individuals might be ready to revise when faced with potent counterexamples (Baron & Leshner, 2000).

TABLE 1: Descriptive statistics.

Measures	Range	Mean (SD)	$\alpha$
1. Low-Granularity			
“Disgusting”	1.00 – 5.57	3.83 (0.88)	-
2. High-Granularity			
OI	0.38 – 4.86	2.60 (1.09)	0.90
Creeped out	0.00 – 5.00	2.42 (1.21)	-
ED	0.21 – 5.21	2.33 (1.11)	0.82
Run away	0.00 – 5.00	2.05 (1.14)	-
Disapprove	0.00 – 4.24	1.45 (1.02)	0.94
Cry	0.00 – 4.71	0.96 (0.99)	-
Happy	0.00 – 2.14	0.14 (0.36)	-
3. Moral-political			
AONT	0.00 – 4.67	3.39 (1.14)	0.72
MFQ-P	0.17 – 4.83	2.23 (0.95)	0.77
MFQ-J	2.00 – 4.83	3.63 (0.65)	0.66
SocCon	1.00 – 6.00	2.33 (1.46)	-
EconCon	1.00 – 7.00	3.72 (1.51)	-
TRAD	0.50 – 4.83	1.84 (0.99)	0.84
SDO	1.00 – 4.50	1.98 (0.86)	0.66

Note: OI = Oral Inhibition, ED = Epidermal Discomfort, AONT = Absolutist opposition to new technology, TRAD = Traditionalism, SDO = Social dominance orientation, SocCon = Social conservatism, EconCon = Economic conservatism.

(*EconCon*) Conservatism (1 = extremely liberal; 7 = extremely conservative) along with sex, age, and *Religiosity (Religion)*. (See Appendix B for the exact wording of each survey.)

### 3 Results

The TDDS-P items evoked a wide range of negative reactions (see Table 1). *OI* and *Creeped out* were the highest rated affective measures, with *OI* ratings significantly exceeding *ED*, *Disapproval*, *Run away*, *Cry*, and *Happy* ( $ps < 0.01$ ), while being statistically indistinguishable from *Creeped out* ( $p = 0.771$ ). A repeated-measures ANOVA with Bonferroni adjustment found all negatively valenced responses to be significantly above the ratings of our control measure *Happy* ( $ps < 0.001$ ).

Analyses of zero-order correlations showed that participants’ ratings of “Disgusting” elicited during the standard administration of the scale were significantly and positively correlated with a variety of negative reactions obtained dur-

TABLE 2: Zero-order correlation among low- (standard administration) and high-granularity negative affective ratings in Rounds 1 and 2.

Measures	1	2	3	4	5	6
1. “Disgusting”	-					
2. OI	0.500	-				
3. ED	0.446	0.729	-			
4. Creeped out	0.449	0.590	0.685	-		
5. Run away	0.396	0.642	0.672	0.611	-	
6. Disapprove	0.359	0.502	0.600	0.482	0.568	-
7. Cry	0.298	0.638	0.584	0.537	0.619	0.490

Note: All *r*’s significant at  $p < 0.001$ ;  
 OI = Oral Inhibition, ED = Epidermal Discomfort.

ing the high-granularity administration of the scale (Table 2).

Follow-up contrasts of paired correlations showed that “Disgusting” was no more strongly correlated with *OI*, a set of responses (nausea, loss of appetite, gagging) comprising the theoretical meaning of disgust (e.g., Nabi, 2002), than it was with *Epidermal discomfort* (Steiger’s  $z=0.958$ ,  $p=0.337$ ), *Creeped out* ( $z=0.744$ ,  $p=0.456$ ), *Disapproval* ( $z=1.826$ ,  $p=0.07$ ), and *Run away* ( $z=1.592$ ,  $p=0.111$ ). This pattern is consistent with that evident from our prior work (Royzman et al., 2008) and lends further support to Kayyal et al.’s (2015) and others’ (Royzman & Sabini, 2001) proposition that (even in the context of pathogen-linked events) “disgust,” “disgusting” and their cognates are often used as proxies for *general dislike*.

Replicating Scott et al.’s (2016) earlier results, “Disgusting” was a significant predictor of *GMF* ( $r=0.252$ ,  $p=0.004$ , 95% CI: [0.084, 0.407]) as well as a near-significant/significant predictor of absolutist opposition to nuclear power/stem cell research ( $r=0.169$ ,  $p=0.054$  and  $r=0.189$ ,  $p=0.031$ , respectively), two technologies with no ties to food production.

However, while opposition to *GMF* was significantly correlated with *Creeped out* ( $r=0.249$ ,  $p=0.004$ , 95% CI: [0.081, 0.404]), it was largely unrelated to *OI* ( $r=0.026$ ,  $p=0.773$ , 95% CI: [-0.147, 0.197]), a set of responses (nausea, loss of appetite, gagging) comprising the theoretical meaning of disgust. Correlations between *OI* and opposition to nuclear power/stem research were equally low ( $rs = -0.048$  and  $-0.004$ , respectively). Indeed, *OI* did not significantly correlate with any socio-moral attitude, including the allegedly disgust-based (Haidt, Koller & Dias, 1993; Haidt, 2012) considerations of moral purity (MFQ-P) and social traditionalism (TRAD).

Since ratings of opposition to *GMF*, *nuclear energy*, and *stem cell research* were highly inter-correlated ( $\alpha=0.72$ ), all

TABLE 3: Univariate correlations between low- and high granularity measures, socio-moral traits, and attitudes towards *GMF* and *New Technologies (AONT)*.

	GMF	AONT
Low-granularity		
“Disgusting”	0.25**	0.25**
High-granularity		
Oral Inhibition (OI)	0.03	-0.01
Creeped out	0.25**	0.23*
Epidermal discomfort (ED)	0.18*	0.15
Disapproval	-0.04	0.01
Run away	0.001	0.004
Cry	0.05	0.05
Socio-moral traits		
Economic Conservatism	0.00	0.11
Social Conservatism	0.08	0.24**
Traditionalism	0.29**	0.39**
Social Dominance Orientation	-0.18*	-0.17*
MFQ-Justice	0.21*	0.23*
MFQ-Purity	0.35**	0.46**

Notes: \*  $p \leq 0.05$ , \*\*  $p < 0.01$

loading on a single factor<sup>7</sup>, we averaged them (range: 0-4.67, Mean [SD] = 3.39 [1.14]), to form an “absolutist opposition to new technologies” (*AONT*) measure, then calculated zero-order correlations between “Disgusting”/*OI* and *AONT*. As with individual items, “Disgusting” was a significant correlate of *AONT* ( $r=0.254$ ,  $p=0.004$ ), while *OI* did not correlate with it at all ( $r=-0.01$ ,  $p=0.898$ ) (see Table 3).<sup>8</sup>

Given the previously established association between feeling “creeped out” and the perception of a potential threat to one’s safety (see McAndrew & Koehnke, 2016; see also Appendix A), our results lend support to Gray and Schein’s (2016) thesis that harm is important to moralizing human conduct in general and certain types of technological developments in particular (see also Royzman et al., 2009) (but see Inbar, Scott & Rozin, 2016 for a response to Gray and Schein’s [2016] conceptual and statistical critique).

<sup>7</sup>The Principal Component Analysis indicated that the single-factor solution (Eigenvalue=1.932, factor loadings between 0.763 and 0.870) was notably preferable to the alternatives (Eigenvalues=0.668 and 0.399).

<sup>8</sup>In order to better mirror Scott et al (2016)’s analyses in Table 1 (Scott et al., 2016, p. 321), we regressed *AONT* and *GMF* on the high-granularity and socio-political items. The results are presented in Appendix D (Table 4). *Creeped out* was a unique predictor of *AONT* ( $b = 0.271$ ,  $t = 2.677$ ,  $p = .009$ ) and *GMF* ( $b = 0.370$ ,  $t = 2.803$ ,  $p = .006$ ), with other affective and socio-political items taken into account (see <http://journal.sjdm.org/stat.htm> for important caveats for interpreting results of a multi-variate analysis).

## 4 Discussion

We draw five main conclusions. First, our data indicate that Scott et al.'s (2016) original result—traditionally assessed trait disgust is a modest yet significant predictor of absolutist opposition to genetically modified food—is quite robust. The finding replicated with a newer, psychometrically improved measure of DS, a different subject population, and various accommodations to mitigate reactivity concerns. The finding also extends to at least two other types of new technologies: nuclear power and stem cell research.

Relatedly, we find that, at least within our multi-national sample of college undergraduates, absolutist opposition to GMF is part of a more wide-ranging pattern of opposition toward new technology in general, with those favoring absolutist restrictions on GMF tending to favor absolutist restrictions on other technologies as well.

Third, consistent with Nabi's (2002) and others' proposition that "disgust", "disgusting" and their cognates are commonly used as stand-ins or proxies for *general dislike*, we find that, even in the context of ostensibly pure "pathogen-linked events", "disgusting" is as likely to refer to fear, disapproval, and epidermal discomfort as it is to refer to oral inhibition proper, highlighting the overarching concern with polysemy of affective terms, i.e., that the meaning of the terms may vary considerably depending on the context and linguistic community (researchers vs. lay public) involved (Royzman, McCauley & Rozin, 2005; see also Nabi, 2002; Kayyal et al., 2015).

Fourth, we showed that the precise operationalization of disgust has a strong impact on findings related to GMF. Once operationalized in a semantically precise way (one that does justice to disgust's unique standing as "a guardian of the mouth" [Olatunji & Sawchuk 2005, p. 935] and a category of food rejection [Angyal, 1941; Darwin, 1872/1965; Nabi, 2002; Olatunji & Sawchuk 2005; Royzman & Sabini, 2001; Royzman et al., 2008; Rozin and Fallon, 1987; Yoder et al., 2016]), susceptibility to *feeling disgusted* (i.e., *orally inhibited*) did little to predict absolutist opposition to GMF and other new tech. This negative result is the very opposite of a conclusion one would have reached had one relied solely on traditional means of disgust assessment, i.e., asking people about the degree to which they find a set of putative pathogen-linked events "disgusting".

Instead, consistent with prior work on fear and GMF (Laros & Steenkamp, 2004; Rzymiski & Królczyk, 2016; Ventura et al., 2016), we find that the internally cohesive pattern of absolutist opposition to the new technologies sampled in this study was best predicted by the shared affective sensitivity to being unnerved or "creeped out" in the face of uncertain or ill-defined threats. This result gains further support from the three convergent sources of evidence outlined in the earlier sections of the paper — (a) classic body of work in the psychology of risk perception showing that

fear is "the major determiner of public perception and acceptance of risk for a wide range of hazards" related to new technology (Slovic & Peters, 2006, p. 322; see also Fischhoff et al., 1978; Sjöberg, 2000, Slovic & Peters, 2006; van der Pligt et al., 1986), (b) Kahan's (2016) convergent demonstration of a positive association between worries over GMF and higher sensitivity to a variety of risks, (c) our finding that our subjects' propensity to rate the TDDS-P items as "disgusting" was as high a predictor of their absolutist opposition to nuclear power, a technology with strong ties to fear and no apparent ties to food production, as it was of their absolutist opposition to GMF.

The negative findings that we report, i.e., the lack of any discernable association between granularly measured trait disgust and moral opposition to GMF, are particularly hard to dismiss and fit well with other recent lines of research (see Royzman et al., 2009; Royzman, Goodwin & Leeman, 2011; Royzman, Atanasov, Landy, Parks & Gepty, 2014; Royzman et al., 2015 for related results). This includes a major meta-analysis by Landy and Goodwin (2015). In reviewing over fifty studies, published and otherwise, Landy and Goodwin (2015) determined that the effect of incidental (experimentally induced) disgust on moral judgment was weak at best ( $d = .11$ ) and disappeared entirely when publication bias was taken into account. (For a recent replication, see Johnson et al. [2016], who showed that the null results remain in effect with or without hypothesized moderators factored in.) Most pertinently, Landy and Goodwin (2015) found that the effect of induced disgust was "*essentially nonexistent* for imagined or mental inductions" (p. 530, emphasis added) (i.e., the type of "inductions" one would experience while thinking of, or dwelling on, GMF), with all effects being essentially near zero or negative *and* near zero (on this point, see also Baron, Royzman and Goodwin, 2013, and Gray and Schein, 2016). These findings are not referenced by Scott et al. (2016) whose stated goals include exploring disgust "as a cause" of "moral opposition" to genetically modified food (p. 317)<sup>9</sup> (described as a "disgust-based" prohibition [p. 316, p. 319, p. 322]) and who argue that their data "underscore the power of affect to shape beliefs about the acceptability of new technologies" (p. 320, emphasis added). The "shaping" would have presumably occurred as those with higher trait scores felt more disgusted while thinking of/dwelling on GMF, becoming more opposed in the end. But Landy and Goodwin's (2015) work makes this unlikely: the mechanism required is not there.<sup>10</sup>

<sup>9</sup>According to Scott et al. (2016), one of the paper's key concerns was: "What role does disgust play — as a cause and/or consequence — in moral opposition to GM?" Given the implausibility of a claim that overall higher DS could emerge as a consequence of one's moral opposition toward GMF, it is reasonably clear that Scott et al. are casting trait disgust as a cause.

<sup>10</sup>An alternate account would suggest that those with high trait scores may gravitate toward some form of political engagement where anti-GMF beliefs are widely shared. One's views would then be "shaped" by these groups. However, Scott et al.'s (2016) own data seem to rule this out by

As the forgoing analysis illustrates, establishing a link between putative feelings of disgust and moral phenomena of interest is no easy matter and requires careful methodological consideration. The key requirement for all future work in this area will be to assess disgust (and other affective variables) in a highly granular manner. Moreover, because negative feelings do co-occur and because having disgust (even if granularly assessed) as the only response option may cause one to use it as a stand-in for other forms of negative affect, a revised disgust scale must feature a menu of non-disgust options including ED and normative disapproval, with all the options being tethered to a common set of items (e.g., stepping in a dog poop) rated on a common scale. The strength of a disgust-morality link could then be properly ascertained by examining the extent to which high-granularity ratings of DS uniquely relate to a moral variable of interest as the two measures are administered days or weeks apart (see above for the rationale) while taking other affective variables into account.

These methodological recommendations are complementary to those adduced in our previous research that demonstrated just how little “moral disgust” is in evidence when using “purity”-based vignettes that neither contain nor (and this is a key requirement) *call to mind* pathogen-linked content, such as the thoughts of death, disablement, and disease (Gray & Schein, 2016) likely to be engendered by GMF in those opposed to GMF (Royzman et al., 2014; see also Yoder et al., 2016).

Lastly, our data offer a viable resolution to a thorny and practically consequential debate regarding the role of *feeling* vs. *harm* in the etiology of people’s resistance to GMF (Scott et al., 2016; Gray & Schein, 2016). As adumbrated above, the two perspectives are relatively easy to reconcile once we grant that the feeling in question is not disgust but the affective output of a harm-vigilance mechanism designed to protect our evolutionary ancestors from costly false negatives (e.g., “seeing” a bear as shrub) by having them err on the side of caution instead.

One possible criticism of our work is that the lay meaning of “creeped out” requires some further analysis and elucidation. We agree. However, as demonstrated in Appendix A, we were cognizant of this concern and carried out a supplementary study to address it in advance (employing a set of subjects drawn from our main sample). These subjects tended to predominantly associate “feeling creeped out” with “nervousness/unease” regarding a *potential* threat, but *not* with certain danger or disgust (“feeling sickened/grossed out”) / perceived risk of contamination, thus clearly conceptualizing “creeped out” as a special member of the fear family. The same conclusion was reached by McAndrew and Koehnke (2016) based on a large international sample of 1341 individuals responding to an online survey. Indeed,

finding no association between politics and attitudes toward GMF (our data bear this out just as well).

we would argue that at this juncture the discriminant validity of “creeped out” as a measure of a fear-like state is far better established than the discriminant validity of “disgust”/“disgusting” as a measure of the theoretical meaning of disgust as a “food rejection” response (Olatunji & Sawchuk, 2005, p. 935; see also Nabi, 2002 and above).

Another criticism of our approach would be that the measure of trait disgust (TDDS-P) that we employed (along with Kahan [2016] and Landy and Piazza [2016]) was substantially shorter and narrower than DS-R, with the relative “narrowness” of TDDS-P being largely due to its exclusion of the “reminders of animal origins” vignettes. The criticism is factually correct, but, as noted above, we see the absence of these items as a benefit rather than a drawback. Not only the “animal reminder” items (e.g., a person walking through a cemetery, a person is spending a night in a hotel room where someone recently passed away) have been argued to be more closely linked to fear than disgust (thus, further confounding any clear assessment of disgust vs. fear; see Tybur et al., 2016), but the entire rationale for their inclusion — an untested hypothesis that “anything that reminds us that we are animals elicits disgust” (Rozin et al., 2008, p. 761) — has recently been tested and disconfirmed. Following a line of thought that humans can compare themselves to animals in a number of favorable ways without feeling disgusted (Royzman & Sabini, 2001; Tybur et al., 2009), Kollareth and Russell (2016) conducted six studies that closely examined and found no support for the “animal reminder” hypothesis.<sup>11</sup> In our view, the sum total of these considerations makes any further use of trait disgust scales that include “animal reminder” items both theoretically unjustified and (due to these items’ high potency as fear/creepiness-elicitors) psychometrically ill-advised. We must also reiterate that, from the purely practical point of view, the 25-item DS-R utilized by Scott et al. (2016) would have been unwieldy due to its sheer length (crossing 25 DS-R items with 12 high-granularity ratings see above would have resulted in a total of 300 separate questions for the high-granularity condition of the study).

One further criticism of our results is that all our data were based on an undergraduate student sample that is not nearly as large or demographically diverse as its representative counterpart utilized by Scott et al. (2016). We agree with the general thrust of this criticism, but would argue that several important caveats are in order. First, as noted above, our study has closely replicated Scott et al.’s (2016) finding of a significant yet modest positive association between DS

<sup>11</sup>Using respondents from both North America and India, the six studies revealed that, though the pleasant “animal reminder” stimuli reminded subjects of their animal origins even more strongly than the unpleasant counterparts, they were not disgusting; nor there was any significant association between disgust and being reminded of one’s animal origins via the unpleasant “animal reminder” stimuli; and no disgust was elicited by directly calling subjects’ attention to their animal pedigrees (Kollareth & Russell, 2016).

and absolutist opposition to GMF. Second, as previously discussed, our findings substantially converge with those recently reported by Kahan (2016), who did use a large, representative U.S. sample ( $N \approx 1200$ ). Third, several key demographic factors thought to be insufficiently varied in undergraduate student samples relative to their more representative counterparts, such as students' lower conservatism and religiosity, along with higher education and family income, apparently played little role in people's opposition to GMF. According to Scott et al.'s (2016) own findings from a multiple regression model (Table 1, p. 321) ( $N = 680$ ), the reported relationship between disgust and favoring restrictions on the use and development of GMFs held even with conservatism, education, religiosity, ethnicity, income, and education included in the model. According to the model, none of the aforementioned variables (conservatism, education, religiosity, ethnicity, income, and education) had a substantial relationship to favoring restrictions on GMF. Fourth, though our sample was clearly less representative than Scott et al.'s (2016) of the U.S. population as a whole, it was far more representative of the world (a matter of great consequence given that opposition to GMF is global issue, with some of the most extreme anti-GMF positions being held by people and polities outside the U.S. [Bain & Dandachi, 2014]) — more than 40 percent of our subjects were raised in or had their primary residence outside the U.S. Scott et al.'s (2016) sample was limited to the U.S. paid on-line survey takers by design. Finally, one considerable advantage of using a younger, undergraduate cohort is indicated by the composition of McAndrew and Koehnke's (2016) sample (mean age = 29, with the unstated median being, most likely, considerably lower). Since slang terms often change across time, using individuals of the same generation as McAndrew and Koehnke's subjects has likely contributed to stabilizing the primary meaning of "creeped out" among our subjects in a way that matched the intended meaning derived from McAndrew and Koehnke's (2016) report. (Indeed, McAndrew and Koehnke's data suggest that the association between "creeps", "creepiness", "creeped out" and a sense of threat was far more pronounced among their younger subjects than among their older cohort).

Resolving the debate between fear and disgust has important policy implications. While some work shows that communicating the benefits of GMFs and other technologies can improve public acceptance of GMFs (Costa-Font, Gil & Traill, 2008), scientists and policy makers need to continue pursuing new methods of persuading the general public to support these new technologies. Our results suggest that one successful strategy may be to demystify the scientific processes underlying genetic engineering. This information would not communicate relative harms and benefits per se — which has been the dominant strategy taken so far — but would rather increase the public's awareness of the process and thus (hopefully) reduce the degree to which GMFs

are conceptualized as odd, mysterious, and strange, making them into a less "unknown" (and, hopefully, far less "creepy") quantity.<sup>12</sup> Lending credence to the potential efficacy of this approach, a recent national Pew survey found that those with more knowledge of science were more likely to see GMOs as safe to eat (Funk & Rainie, 2015).

All in all, the results presented herein, while hardly definitive, are very much in line with prior theorizing and research (e.g., Cameron et al., 2015; Kahan, 2016; Kayyal et al., 2015; Landy & Goodwin, 2015; Landy & Piazza, 2016; Nabi, 2002; Rozman & Sabini, 2001; Rozman et al., 2008) and warrant the field's attention. If heeded, they stand to improve the current research practices both conceptually and methodologically, yielding more accurate policy prescriptions down the line.

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<sup>12</sup>One important objective within this approach would be to make participants aware that GMF is just "breeding" done faster (and more selectively) for the traits of interest, calling their attention to the fact that almost all the fruits and vegetables (and some animals) that we eat are not "natural" in this sense, but were bred over centuries with a specific purpose in mind.

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## Appendix

### A. Supplementary survey (“creeped out” meaning check)

To confirm that our understanding of “creeped out” (derived from the analyses of McAndrew and Koehnke, 2016) was in line with participants’ own conception of the term, a randomly selected subset of students ( $n = 42$ ) were asked to consider an additional set of questions one week following the completion of Survey 3. Two questions were presented in a fixed random order with response options partially counterbalanced for order.

The first question read: “Please indicate (using a checkmark) which of the following BEST describes or comes CLOSEST to what you are usually feeling when you speak of someone or something **creeping you out**.” The response options included (in partially counterbalanced order): “*Feeling nervous/uneasy*”, “*Feeling angry/pissed off*”, “*Feeling happy/excited*”, “*Feeling sickened/grossed out*.”

The second question read: “Please indicate which of the following comes CLOSEST to expressing your state of mind when you are feeling or being genuinely **creeped out**.” The response options included (in partially counterbalanced order): “*It feels very safe, cozy, and secure*,” “*It feels like there is a possible threat from some strange and unpredictable source*,” “*It feels like I am being treated unfairly*,” “*It feels like I just lost something of value*,” “*It feels like I am being contaminated*,” “*It feels like I am in some clear and immediate danger*.” (The subjects were verbally instructed that if they thought that two or more response options were equally appropriate in a given case they were welcome to check all that applied).

In line with McAndrew and Koehnke’s (2016) results, the majority of subjects selected “*Feeling nervous/uneasy*” (35 out of 42 or 83.3 percent) for question 1 and “*It feels like there is a possible threat*” (34 out of 42 or 81 percent) for question 2. In either case, the relative frequency of the dominant response choice was significantly greater ( $p < 0.001$  in either case by Chi-squared test as recommended by Campbell [2007]) than that of the next most common response choice—the “*Feeling sickened/grossed out*” option (7 out of 42 or 16.7%) for question 1 and the “*It feels like I am being contaminated*” option (9 out of 42 or 21.4%) for question 2, respectively.

During the following group discussion, subjects indicated that the possible threat most closely linked to “creeped out” was that of a physical (including sexual) assault.

### B. Additional survey text and administration details.

**General data collection.** Surveys were administered over the web using Qualtrics. Participants were notified via email

when the survey was launched and were invited to complete the survey on their own before it closed one week later.

#### TDDS-P: Standard (low granularity) administration.

All seven scenarios were presented in a fixed order

**Instructions.** Please rate how disgusting you find the concepts described in the items (e.g. **Stepping on dog poop**), where **0** means that you did not find the concept disgusting at all and **6** means that you found the concept disgusting to an extreme degree.

- Accidentally touching a person’s bloody cut.
- Seeing a cockroach run across the floor.
- Seeing some mold on old leftovers in your refrigerator.
- Shaking hands with a stranger who has sweaty palms.
- Sitting next to someone who has red sores on their arm.
- Standing close to a person who has body odor.
- Stepping on dog poop.

#### TDDS-P: High-granularity administration.

**Presentation and counter-balancing.** Each of the seven scenarios (see above) was presented on a separate page, with the concept/behavior at the top (e.g. “Stepping in dog poop”) and the 12 high-granularity measures below (e.g. “Stepping in dog poop makes me *feel creeped out*.”). As in the case of the low-granularity administration, the scales ranged from 0 (not at all) to 6 (extremely).

The seven scenarios were individually randomized for each participant. To determine the order of the 12 high-granularity measures for each scenario, we constructed 10 lists each with a different fixed order which remained the same across each of the seven scenarios for that participant. We constructed the first five by randomizing the order of the high-granularity questions, and created five additional orders by reversing each one of those. Participants were randomly assigned to one of these 10 orders when they filled out the survey.

**Instructions.** The following items describe a variety of concepts.

Please rate the extent to which each concept (e.g. **Stepping on dog poop**) makes you feel certain sensations and desires (e.g., feeling creeped out, feeling physically nauseated, wanting to run away, wanting to tell someone off) where **0** means that you did not experience a given sensation/desire at all and **6** means that you experienced it to an extreme degree.

You will do this for seven different concepts.

**High-granularity rating scales***Oral inhibition (OI):*

[Stepping on dog poop] makes me feel physically nauseated  
 [...] makes me gag  
 [...] makes me lose my appetite

*Disapprove:*

[...] makes me want to tell someone off  
 [...] makes me want to disapprove of someone  
 [...] makes me want to reprimand someone

*Epidermal discomfort (ED):*

[...] makes me feel a crawling sensation on my skin  
 [...] makes me want to shake something off me

*Creeped out:*

[...] makes me feel creeped out

*Run away:*

[...] makes me want to run away

*Other:*

[...] makes me feel like crying  
 [...] makes me feel happy

**Survey 3**

**Presentation and counterbalancing.** In addition to the New Technology items, participants were asked to complete 6-item Purity and Fairness scales from the Moral Foundations Questionnaire (MFQ), the 6-item short form of the Traditionalism facet of the Authoritarianism-Conservatism-Traditionalism scale (ACT-T), as well as the 4-item short Social Dominance Orientation scale (SDO). The order of all measures was randomly determined for each participant. See below for the full reference, text and response scale for each item.

Lastly, participants filled out a short demographic form asking for their Social and Economic political identity, Age, Sex, and Religiosity.

**Moral Foundations Questionnaire (Graham, Haidt & Nosek, 2009)**

When you decide whether something is right or wrong, to what extent are the following considerations relevant to your thinking? Please rate each statement using this scale:

[0] = not at all relevant (This consideration has nothing to do with my judgments of right and wrong)

[1] = not very relevant

[2] = slightly relevant

[3] = somewhat relevant

[4] = very relevant

[5] = extremely relevant (This is one of the most important factors when I judge right and wrong)

\_\_\_ Whether or not some people were treated differently than others

\_\_\_ Whether or not someone violated standards of purity and decency

\_\_\_ Whether or not someone acted unfairly

\_\_\_ Whether or not someone did something disgusting

\_\_\_ Whether or not someone was denied his or her rights

\_\_\_ Whether or not someone acted in a way that God would approve of

Please read the following sentences and indicate your agreement or disagreement:

[0] = Strongly disagree

[1] = Moderately disagree

[2] = Slightly disagree

[3] = Slightly agree

[4] = Moderately agree

[5] = Strongly agree

\_\_\_ When the government makes laws, the number one principle should be ensuring that everyone is treated fairly.

\_\_\_ People should not do things that are disgusting, even if no one is harmed.

\_\_\_ Justice is the most important requirement for a society.

\_\_\_ I would call some acts wrong on the grounds that they are unnatural.

\_\_\_ I think it's morally wrong that rich children inherit a lot of money while poor children inherit nothing.

\_\_\_ Chastity is an important and valuable virtue.

**New technologies (based on Baron & Spranca, 1997)**

Please read the following sentences and indicate your agreement or disagreement:

[0] = Strongly disagree

[1] = Moderately disagree

[2] = Slightly disagree

[3] = Slightly agree

[4] = Moderately agree

[5] = Strongly agree

There should be restrictions on the use of embryonic stem cells no matter how great their benefits and how minor their risks.

There should be restrictions on the use of genetically modified foods (e.g., genetically modified salmon) no matter how great their benefits and how minor their risks.

There should be restrictions on commercial use of nuclear power (e.g., nuclear power plants) no matter how great its benefits or how minor its risks.

**Social Dominance Orientation (Pratto et al., 1994)**

There are many types of groups in the world: men and women, ethnic and religious groups, nationalities, political factions, etc. Please rate the degree to which you oppose or favor each statement about groups, where higher numbers mean you favor the statement more, and lower numbers mean you oppose the statement more.

[1–7 scale from [1] = “Extremely oppose” to [7] = “Extremely favor”.]

In setting priorities, we must consider all groups. [R]

We should *not* push for group equality.

Group equality should be our ideal [R]

Superior groups should dominate inferior groups.

### Traditionalism (Duckitt et al., 2010)

The following questions concern ideas that people may or may not hold. Please indicate the degree to which you disagree or agree with each statement, where higher numbers mean you agree with the statement more and lower numbers mean you disagree with the statement more.

[0] = Strongly disagree

[1] = Moderately disagree

[2] = Slightly disagree

[3] = Slightly agree

[4] = Moderately agree

[5] = Strongly agree

The “old fashioned ways” and “old fashioned values” still show the best way to live.

God’s laws about abortion, pornography, and marriage must be strictly followed before it is too late.

There is absolutely nothing wrong with nudist camps.

This country will flourish if young people stop experimenting with drugs, alcohol, and sex, and pay more attention to family values.

There is nothing wrong with premarital sexual intercourse.

Nobody should stick to the “straight and narrow.” Instead, people should break loose and try lots of different ideas and experiences.

### Ideological orientation

In general, how liberal or conservative would you say you are on **economic issues**?

[1] = Very liberal

[2] = Liberal

[3] = Slightly liberal

[4] = Middle-of-the-road

[5] = Slightly conservative

[6] = Conservative

[7] = Very Conservative

In general, how liberal or conservative would you say you are on **social issues**?

[same scale]

### C. Additional demographic information about the sample and hypothesis manipulation check

Three weeks after administering Survey 3, we contacted study participants to gather additional demographic information, including their ethnic identity, religious identity, and country of origin (see below). We also asked participants to guess the purpose of the experiment. Out of 113 students who completed the survey, only three correctly inferred that our interests lay at the intersection of morality and emotion, with all three speculating that the affective variable of interest was disgust, and that the socio-moral variable under consideration was “moral judgment,” perception of social norms, or political orientation, respectively.<sup>13</sup>

**Country of Origin.** The sample included a large number of international students, with 39.5% of the group claiming “a country of origin” other than the US (contact authors for further details). Collectively, they represented a total of 29 countries, including Brazil, Canada, China, Columbia, France, India, Israel, Malaysia, Mexico, Myanmar, Paraguay, Russia, South Korea, Spain, and UK, among others.

**Ethnicity.** The five most commonly reported ethnicities were White/Caucasian (39.5 percent), East-Asian or East-Asian-American (20.1 percent), Latin/Hispanic (16.8 percent), African or African-American (8.4 percent), and South-Asian or South-Asian-American (5.9 percent).

<sup>13</sup>All remaining subjects viewed the study as an exploration of disgust as such. No participant ventured a guess that the project was about (or made any reference to) new technology in general or GMF in particular or posited any connection between feeling creeped out and either of the above.

**D. Multivariate analyses**

TABLE 4: Least-squares regression model estimating the relationship between high-granularity measures of negative affect/socio-moral variables and absolutist opposition to new technologies (AONT) and genetically modified foods (GMF).

IV	AONT model				GMF model			
	b	(SE)	t	p	b	(SE)	t	p
Intercept	-7.976	(3.760)	-2.121	0.036	-10.71	(4.896)	-2.187	0.031
Creeped out	0.271	(0.101)	2.677	0.009**	0.370	(0.132)	2.803	0.006**
OI	-0.193	(0.128)	-1.503	0.136	-0.251	(0.167)	-1.502	0.136
Disapproval	-0.034	(0.122)	-0.281	0.779	-0.200	(0.159)	-1.258	0.211
ED	0.061	(0.146)	0.420	0.675	0.263	(0.190)	1.386	0.169
Run away	-0.188	(0.121)	-1.555	0.123	-0.263	(0.157)	-1.672	0.097
Cry	-0.003	(0.127)	-0.021	0.983	0.014	(0.165)	0.082	0.935
MFQ-Purity	0.343	(0.128)	2.689	0.008**	0.347	(0.166)	2.087	0.039*
MFQ-Fairness	0.243	(0.160)	1.524	0.130	0.134	(0.208)	0.645	0.520
SocCon	0.040	(0.081)	0.495	0.622	-0.100	(0.105)	-0.953	0.343
EconCon	0.049	(0.069)	0.719	0.474	0.031	(0.090)	0.346	0.730
Religious	0.045	(0.062)	0.730	0.467	0.078	(0.081)	0.965	0.337
Sex	0.381	(0.196)	1.947	0.054	0.398	(0.255)	1.561	0.121
Age (Log)	5.945	(2.715)	2.190	0.031*	8.398	(3.536)	2.375	0.019*
TRAD	0.139	(0.140)	0.994	0.322	0.144	(0.182)	0.790	0.431
SDO	-0.130	(0.120)	-1.080	0.282	-0.149	(0.157)	-0.949	0.345
$R^2 = 0.406$ , Adjusted- $R^2 = 0.327$				$R^2 = 0.339$ , Adjusted- $R^2 = 0.251$				

Notes: \*  $p \leq 0.05$ , \*\*  $p < 0.01$

Labels: OI = Oral Inhibition, ED = Epidermal Discomfort, SocCon = Social conservatism, EconCon = Economic conservatism, TRAD = Traditionalism, SDO = Social dominance orientation, MFQ-J = Moral Foundations Questionnaire Justice subscale, MFQ-P = Moral Foundations Questionnaire Purity subscale.