PSYCHOLOGICAL ASPECTS OF FOOD BIODESIGN

Michael J. Saks, Alexander F. Danvers, Roselle L. Wissler, Mariya K. Voytyuk, Keelah E.G. Williams, Denise A. Baker, and Ashley M. Votruba*

ABSTRACT: In light of what is known of the cognitive, social, developmental, and evolutionary psychology of human food choice, the anxiety and resistance prompted by genetically modified (GM) foods is unsurprising. The underlying psychological mechanisms that govern food preferences suggest why GM foods have become so controversial so easily. Views of government regulation and business practices also play a role in the public reaction to GM foods.

CITATION: Michael J. Saks, Alexander F. Danvers, Roselle L. Wissler, Mariya K. Voytyuk, Keelah E.G. Williams, Denise A. Baker, and Ashley M. Votruba, Psychological Aspects of Food Biodesign, 56 Jurimetrics J. 165–181 (2016).

Unlike many technological advances, genetically modified (GM) foods have been greeted with exceptional anxiety, resistance, turmoil, and controversy.[1] Surveys conducted since 2000 generally have found only a minority of Americans to have favorable views of GM products, while most have either negative views or are unsure about GM foods. Depending on the survey, only 16% to 37% of Americans think that GM foods or crops are safe or healthy to eat, or are safe for the environment.[2] Far more (52% to 57%) believe that GM

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*Author Notes: All authors are at the Arizona State University, Tempe, AZ 85287. Saks: Regents Professor, Sandra Day O'Connor College of Law and Department of Psychology, saks@asu.edu; Danvers: Graduate Student, Department of Psychology, alexander.danvers@asu.edu; Wissler: Director of Research, Lodestar Dispute Resolution Program, Sandra Day O'Connor College of Law, rwissler@asu.edu; Voytyuk: PhD Candidate, School of Human Evolution & Social Change, mvoytyuk@asu.edu; Williams: Graduate Student, Department of Psychology and Law Student, Sandra Day O'Connor College of Law, keelah.williams@asu.edu; Baker: Graduate Student, Human & Social Dimensions of Science & Technology, dbaker@asu.edu; Votruba: Graduate Student, Department of Psychology and Law Student, Sandra Day O'Connor College of Law, ashley.votruba@asu.edu.

1. Gregory N. Mandel, *Confidence-Building Measures for Genetically Modified Products: Stakeholder Teamwork on Regulatory Proposals*, 44 JURIMETRICS J. 41, 41–42 (2003); Sabrina Safrin, *Anticipating the Storm: Predicting and Preventing Global Technology Conflicts*, 46 ARIZ. ST. L.J. 899, 899 (2015).

2. *See Broad Opposition to Genetically Modified Foods: Modest Transatlantic Gap*, PEW RESEARCH CTR. (June 20, 2003) [hereinafter *Broad Opposition to GMFs*], http://www.people-press.org/2003/06/20/broad-opposition-to-genetically-modified-foods/; Gary Langer, *Poll: Skepticism of Genetically Modified Foods*, ABC NEWS (June 19, 2001), http://abcnews.go.com/Technology/print?id=97567 [hereinafter ABC News Poll]; PEW RESEARCH CTR., PUBLIC AND SCIENTISTS' VIEWS ON SCIENCE AND SOCIETY 6 (2015), http://www.pewinternet.org/files/2015/01/PI_ScienceandSociety_Report_012915.pdf [hereinafter PUBLIC AND SCIENTISTS' VIEWS]; Emily Swanson, *GMO Poll Finds Huge Majority Say Foods Should Be Labeled*, HUFFINGTON POST, http://www.

foods or crops are unsafe or bad for human consumption or the environment.[3] Some surveys find majorities or pluralities to be unsure whether GM foods are safe.[4] In addition, 67% believe that scientists themselves do not clearly understand the health effects of GM foods.[5]

Most Americans say they would avoid buying GM foods[6] and would be willing to pay more to do so.[7] The vast majority (in some surveys as many as 93%) express the view that GM food products should be labeled.[8] Notwithstanding strong public preferences for labeling, GM advocates have mounted challenges to and have defeated ballot propositions that would have required labeling in California (2012), Washington (2013), Oregon (2014), and Colorado (2014).[9] Vermont passed the first state law to go into effect that requires mandatory labeling of GM food products.[10] Industry-backed federal legislation

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huffingtonpost.com/2013/03/04/gmo-poll_n_2807595.html (last updated June 11, 2013); THOMSON REUTERS, NATIONAL SURVEY OF HEALTHCARE CONSUMERS: GENETICALLY ENGINEERED FOOD 1, 4 (2010), http://www.justlabelit.org/wp-content/uploads/2011/09/NPR_report_GeneticEngineeredFood-1.pdf.

3. *See* ABC News Poll, *supra* note 2; *Broad Opposition to GMFs*, *supra* note 2.

4. *E.g.*, Swanson, *supra* note 2; THOMSON REUTERS, *supra* note 2, at 4.

5. *See* PUBLIC AND SCIENTISTS' VIEWS, *supra* note 2, at 8. Other studies also found that focus group participants were concerned that scientists, industry, and government are not adequately taking into consideration the potential long-term health and environmental impacts of GM foods. Guy Cook et al., *Words of Mass Destruction: British Newspaper Coverage of the Genetically Modified Food Debate, Expert and Non-Expert Reactions*, 15 PUB. UNDERSTANDING SCI. 5, 21–23 (2006); Alison Shaw, *"It Just Goes Against the Grain." Public Understandings of Genetically Modified (GM) Food in the UK*, 11 PUB. UNDERSTANDING SCI. 273, 279 (2002). On no other issue studied is the gap between the opinions of scientists and those of the general public so wide as it is regarding the safety of eating GM foods. *See* PUBLIC AND SCIENTISTS' VIEWS, *supra* note 2.

6. ABC News Poll, *supra* note 2.

7. *See* Naoya Kaneko & Wen S. Chern, Ohio State Univ., Consumer Acceptance of Genetically Modified Foods: A Telephone Survey, Paper Presented at the American Agricultural Economics Association Annual Meeting 1 (July 27–30, 2003), http://www.researchgate.net/profile/Wen_Chern/publication/23505074_CONSUMER_ACCEPTANCE_OF_GENETICALLY_MODIFIED_FOODS_A_TELEPHONE_SURVEY/links/0c96052704a2766c24000000.pdf; Hans P. Peters et al., *Culture and Technological Innovation: Impact of Institutional Trust and Appreciation of Nature on Attitudes Towards Food Biotechnology in the USA and Germany*, 19 INT'L J. PUB. OPINION RES. 191, 203 (2007).

8. Safrin, *supra* note 1, at 936; Swanson, *supra* note 2, at 2; THOMSON REUTERS, *supra* note 2, at 3. Of the 162 public comments submitted following the recent U.S. Food and Drug Administration's approval of GM salmon with labeling strictly voluntary, 97% felt the salmon should clearly be labeled as genetically modified. Elizabeth Glass Geltman, *Public to FDA: Just Say No to GMO Voluntary Labeling*, HUFFINGTON POST (Dec. 11, 2015, 4:16 PM), http://www.huffingtonpost.com/elizabeth-glass-geltman/gmo_2_b_8777924.html.

9. *Search: GMO Food Labels*, BALLOTPEDIA, http://ballotpedia.org/Search?q=gmo%20food%20labels (last visited Mar. 27, 2016).

10. *See* VT. ST. ANN. tit. 9, §§ 3041–3048 (LEXIS through Chapter 69 and Municipal Act 13 of the 2015 Adjourned Session (2016)); Annie Gasparro & Jacob Bunge, *GMO Labeling Law Roils Food Companies*, WALL ST. J., Mar. 21, 2016, at B1; Dan Charles & Allison Aubrey, *How Little Vermont Got Big Food Companies To Label GMOs*, NAT'L PUB. RADIO (Mar. 27, 2016), http://www.npr.org/sections/thesalt/2016/03/27/471759643/how-little-vermont-got-big-food-companies-to-label-gmos; *GE Food Labeling Rule*, VT. OFF. ATT'Y GEN. (Feb. 10, 2016), http://ago.vermont.gov/focus/consumer-info/fuel/ge-food-labeling-rule.php (noting adoption of Consumer Protection Rule CP 121 on Apr. 17, 2015). Several other states had passed GM labeling laws before Ver-

that would have created a voluntary national labeling standard and prohibited states from adopting labeling requirements stalled in the Senate.[11]

Citizens of other high-income nations are even more suspicious of GM products than Americans are.[12] GM fruits and vegetables are regarded as "bad" by 63% to 89% of respondents in Canada, Japan, and Western Europe.[13] In most European nations, labeling of foods containing genetically modified organisms (GMOs) is required.[14]

The public reaction is important not only in relation to individual consumer choices, but also because public opinion influences the dynamics of the marketplace, including choices by retailers of what products to sell, escalating legal requirements, and the possibility of outright bans. Thus, the public's acceptance or rejection of GM foods will determine whether and how those foods are adopted.[15]

Why are the public's views of GM foods as negative as they are? Several Nobel Laureates and other prominent scientists have argued that GM foods evoked nothing more than typical anxieties about new technology until those anxieties were fueled by the propaganda of activists pursuing their own agendas: "New technologies often evoke rumors of hazard. These generally fade with time when, as in this case, no real hazards emerge. But the anti-GMO fever still burns brightly, fanned by electronic gossip and well-organized fear-mongering that profits some individuals and organizations."[16] Good reason exists, however, to believe that something more fundamental is responsible for the nature and depth of people's reactions.

Initially, it should be acknowledged that finding particular GM foods to be safe on all dimensions (consumer health, environmental safety, etc.) cannot logically put to rest all concerns about all GM foods for all time. Like any technological advance, foods containing GM components offer designed benefits along with known and unknown risks. Because of the heterogeneity of GM

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mont, but their effective date was contingent on other states passing similar laws. *See, e.g.*, 2013 Conn. Acts 13-183 (Reg. Sess.); 2014 Me. Laws 565.

11. *See* Gasparro & Bunge, *supra* note 10; Charles & Aubrey, *supra* note 10.

12. Jayson L. Lusk et al., *A Meta-Analysis of Genetically Modified Food Valuation Studies*, 30 J. AGRIC. & RESOURCE ECON. 28, 37 (2005); Peters et al., *supra* note 7, at 202–03.

13. *Broad Opposition to GMFs*, *supra* note 2.

14. Council Regulation 258/97, of the European Parliament and of the Council of 27 January 1997, Concerning Novel Foods and Novel Food Ingredients, 1997 O.J. (L 43) 1.

15. Latifah Amin et al., *Factors Influencing Malaysian Public Attitudes to Agro-Biotechnology*, 20 PUB. UNDERSTANDING SCI. 674, 674 (2011); Heather Dietrich & Renato Schibeci, *Beyond Public Perceptions of Gene Technology: Community Participation in Public Policy in Australia*, 12 PUB. UNDERSTANDING SCI. 381, 381 (2003); Matthew D. Marques et al., *Attitudes to Genetically Modified Food Over Time: How Trust in Organizations and the Media Cycle Predict Support*, 24 PUB. UNDERSTANDING SCI. 601, 602 (2015).

16. Bruce Alberts et al., Editorial, *Standing Up for GMOs*, 341 SCIENCE 1320, 1320 (2013). Which is not to say that media accounts of GMOs do not tend to fuel public worries. *See, e.g.*, Martha Augoustinos et al., *Genetically Modified Food in the News: Media Representations of the GM Debate in the UK*, 19 PUB. UNDERSTANDING SCI. 98, 98 (2010); Cook et al., *supra* note 5, at 9; Steven M. Flipse & Patricia Osseweijer, *Media Attention to GM Food Cases: An Innovation Perspective*, 22 PUB. UNDERSTANDING SCI. 185, 185–87 (2012); Marques et al., *supra* note 15, at 612.

products, each needs to be evaluated in light of its own particular benefit-risk profile.[17] Unqualified categorical pronouncements of commendation as well as condemnation cannot be offered plausibly. Some benefits can be enormously valuable: endowing crops with resistance to pathogens, pests, and environmental stressors; increasing yields; or engineering into crops improved flavor, nutrition, or even vaccines. Although no harms from GM products have been documented to date,[18] some probability of risk inevitably exists—if only for the *next* product or *next* application. Some problems, however, have already materialized—both health (allergenicity[19]) and environmental (outcrossing,[20] pesticide and herbicide resistance[21])—requiring appropriate responses to prevent or mitigate harm. Rational scientists, producers, and regulators are alert to such developments. Indeed, a record of continued safety can be assured only by vigilance to the risks of harm.

Beyond any risk of material dangers, however, we suggest that food is qualitatively different from other technological innovations, and therefore that GM foods inevitably will elicit unusual reactions. The major sources of this difference are to be found through an understanding of the cognitive, social, and evolutionary psychology of human food choice. This article first provides an overview of the current research-based understanding of the psychology of human food preferences and aversions. Then the article examines the situation of GM foods through the lens provided by that more general body of knowledge.

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17. *See* Safrin, *supra* note 1, at 914; Soc'y of Toxicology, *The Safety of Genetically Modified Foods Produced Through Biotechnology*, 71 TOXICOLOGICAL SCI. 2, 2 (2003); *Frequently Asked Questions on Genetically Modified Foods*, WORLD HEALTH ORG., http://www.who.int/foodsafety/areas_work/food-technology/faq-genetically-modified-food/en/ (last visited Mar. 27, 2016).

18. *See, e.g.*, COMM. ON IDENTIFYING & ASSESSING UNINTENDED EFFECTS OF GENETICALLY ENGINEERED FOODS ON HUMAN HEALTH, INST. OF MED. & NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., SAFETY OF GENETICALLY ENGINEERED FOODS: APPROACHES TO ASSESSING UNINTENDED HEALTH EFFECTS 103 (2004); Suzie Key et al., *Genetically Modified Plants and Human Health*, 101 J. ROYAL SOC'Y MED. 290, 293 (2008) A.L. Van Eenennaam & A.E. Young, *Prevalence and Impacts of Genetically Engineered Feedstuffs on Livestock Populations*, 92 J. ANIMAL SCI. 4255, 4255–57 (2014).

19. Julie A. Nordlee et al., *Identification of a Brazil-Nut Allergen in Transgenic Soybeans*, 334 NEW ENGL. J. MED. 688, 688 (1996).

20. Tristan Funk et al., *Outcrossing Frequencies and Distribution of Transgenic Oilseed Rape (*Brassica napus *L.) in the Nearest Neighbourhood*, 24 EUROP. J. AGRONOMY 26, 26 (2006).

21. Carey Gillam, *Pesticide Use Ramping Up as GMO Crop Technology Backfires: Study*, REUTERS (Oct. 1, 2012, 9:18 PM), http://www.reuters.com/article/2012/10/02/us-usa-study-pesticides-idUSBRE89100X20121002; Jack Kaskey, *Attack of the Superweed*, BLOOMBERG BUS. (Sept. 8, 2011, 6:04 PM), http://www.businessweek.com/magazine/attack-of-the-superweed-09082011.html. These problems are not unique to GM crops. *See, e.g.*, Ron Vargas, *Herbicide Resistance*, UNIV. ARIZ. C. AGRIC., www.ag.arizona.edu/crop/pesticides/papers/herbresis.html (last visited Apr. 17, 2016) (reposting of May 2001 article noting the first report of herbicide resistance in 1960, which predated GM crops).

I. PSYCHOLOGY OF FOOD CHOICE

Food is necessary for subsistence, but anything we ingest can carry hidden pathogens and toxins. Human survival has benefitted from evolutionary adaptations that endow us with vigilance about ingestion and the ability to develop emotions, cognitions, and behaviors through experience that facilitate identification and avoidance of diseases and poisons.[22] The suite of psychological processes that help us avoid infection and toxicity is termed the *behavioral immune system*.[23]

The body's physiological immune system battles pathogens after they enter one's body and begin to assault it.[24] Valuable bodily resources must be expended to mount that defense. The behavioral immune system serves to prevent infection in the first place. We tend to avoid things and people we sense present risks of illness. We have negative emotional and behavioral reactions to food that bears signs of infection or that is suspected of being tainted by real or even symbolic contaminants. Similarly, we avoid people, often relying on indirect evidence or heuristic cues, including physical deformity and birthmarks, as well as membership in disfavored groups. Thus, even weak or symbolic associations can trigger the behavioral immune system, leading us to feel revulsion and avoid contact with the sensed risk.[25] Some of those psychological responses might seem extreme, even irrational, until we consider the costly harms they serve to prevent.

A. Asymmetric Sensitivity to Health Risk

Humans are calibrated to be asymmetrically sensitive to health risks—with our signal-detection thresholds set to err much more often by passing up what in actuality are safe foods than by inadvertently consuming foods that are unhealthy.[26] This hypervigilance is evident in various behavior patterns related to food, and is intimately connected to our being food generalists. Unlike species that evolved to consume a single food (e.g., koalas), we can acquire nutrition from a wide variety of food types. This presents us with the *generalist's dilemma*. We experience an approach-avoidance conflict about new foods: we are interested but we also are nervous about them. Thus, we hesitate to eat

22. Arne Öhman & Susan Mineka, *Fear, Phobias, and Preparedness: Toward an Evolved Module of Fear and Fear Learning*, 108 PSYCHOL. REV. 483, 483 (2001) (finding multiple lines of empirical research consistent with an evolved neurological module for fear elicitation and fear learning that is activated by stimuli that are fear relevant in an evolutionary perspective, that produces automatic responses to such stimuli, that is resistant to cognitive modification, and that originates in dedicated neural circuitry, centered in the amygdala).

23. Mark Schaller & Lesley A. Duncan, *The Behavioral Immune System: Its Evolution and Social Psychological Implications*, *in* EVOLUTION AND THE SOCIAL MIND: EVOLUTIONARY PSYCHOLOGY AND SOCIAL COGNITION 293, 295 (Joseph P. Forgas et al. eds., 2007); Mark Schaller & Justin H. Park, *The Behavioral Immune System (and Why it Matters)*, 20 CURRENT DIRECTIONS PSYCHOL. SCI. 99, 99 (2011).

24. *See* sources cited *supra* notes 22 and 23.

25. *See* sources cited *supra* notes 22 and 23.

26. Randolph M. Nesse, *Natural Selection and the Regulation of Defenses: A Signal Detection Analysis of the Smoke Detector Principle*, 26 EVOLUTION & HUMAN BEHAV. 88, 88 (2005).

unfamiliar foods[27] and we learn remarkably quickly and long-lastingly to avoid a food—or the situation associated with eating a food—that made us sick even a single time.

B. Disgust Emotion System

Nature has endowed us with a disgust emotion system whose primary purpose appears to be to avoid infection[28] by defending the borders of the self, both social and physical.[29] Disgust can be triggered by a range of elicitors, including certain foods, body products, animals, body envelope violations, poor hygiene, interpersonal contamination, and moral offenses.[30] Stimuli that initially are neutral can themselves become new and enduring disgust elicitors.[31] Remarkable features of the disgust response are its visceral strength, its low threshold for being triggered, and the fact that it can be activated by symbols. Our affective responses can occur before we have processed much or any cognitive information.[32] For example, research participants recoil against eating fresh soup from a brand new bedpan.[33]

C. Developmental and Learning Processes

Humans are born with few evolved food preferences. Primarily, we are endowed with a collection of mechanisms, mostly involving individual and social learning, that enable us to develop food preferences and aversions reflecting the skewed tendencies described above. As food generalists, learning what is safe and appropriate to eat presents major hurdles.[34] Among the few specific evolved preferences, human children initially prefer sweet and salty substances while rejecting those with sour or bitter tastes.[35] It is easy to see the evolutionary advantages: sweet foods provide energy and salty foods usually are high in protein—both beneficial for early growth. But even these preferences can be changed by experience: children exposed more to sweet, salty, or plain tofu developed a greater liking for the version with which they had

27. *See* HARRY BAKWIN & RUTH M. BAKWIN, BEHAVIOR DISORDERS IN CHILDREN 516 (4th ed. 1972); L. Cooke et al., *Relationship Between Parental Report of Food Neophobia and Everyday Food Consumption in 2–6-Year-Old Children*, 41 APPETITE 205, 205 (2003).

28. ROBERT PLUTCHIK, EMOTION: A PSYCHOEVOLUTIONARY SYNTHESIS 128–37 (George A. Middendorf ed. 1980); Val Curtis et al., *Evidence that Disgust Evolved to Protect from Risk of Disease*, 271 PROC. ROYAL SOC'Y B S131 (SUPP. 2004).

29. Daniel M.T. Fessler & Kevin J. Haley, *Guarding the Perimeter: The Outside-Inside Dichotomy in Disgust and Bodily Experience*, 20 COGNITION & EMOTION 3, 3 (2006).

30. Paul Rozin et al., *Disgust, in* HANDBOOK OF EMOTIONS 757 (Michael Lewis et al. eds., 3d ed. 2008).

31. Paul Rozin et al., *From Oral to Moral*, 323 SCIENCE 1179, 1179 (2009).

32. *See* R.B. Zajonc, *Feeling and Thinking: Preferences Need No Inferences*, 35 AM. PSYCHOL. 151, 151 (1980).

33. Paul Rozin et al., *Operation of the Laws of Sympathetic Magic in Disgust and Other Domains*, 50 J. PERSONALITY & SOC. PSYCHOL. 703, 706–09 (1986) [hereinafter Rozin et al., *Operation of Laws of Sympathetic Magic*].

34. *See* Kristin Shutts et al., *Understanding Infants' and Children's Social Learning About Foods: Previous Research and New Prospects*, 49 DEV. PSYCHOL. 419, 419 (2013).

35. *Id.*; *see also* Julie A. Mennella et al., *Preferences for Salty and Sweet Tastes Are Elevated and Related to Each Other During Childhood*, PLoS ONE, March 2014, at 1–2.

experimentally become more familiar and a decreased liking for the others.[36] Before long, learning takes over. Notably, infants develop aversions to foods consumed close in time to feelings of nausea.

Infants and toddlers are unable to make food choices a priori, willing indiscriminately to ingest many things, including inedible, dangerous, and deadly substances. Most survive because adults control their food selection. Further into toddlerhood, children start to develop skill in selecting what to eat and what to reject, with an emerging emphasis on rejection. Food neophobia (intolerance of the unfamiliar) peaks during early childhood.[37]

As children gradually mature, social learning plays a dominant role in the development of their food preferences and aversions. Children have countless opportunities to observe adults selecting, preparing, and eating various foods, as well as receiving explicit instruction from adults. This learning occurs with inherent biases: welcoming the familiar, approaching novel foods with caution or resistance, more readily accepting novel foods when offered by caregivers than by strangers, and later becoming more influenced by the food preferences of peers than those of adults.[38]

Paul Rozin, the leading student of the psychology of human food preference, suggests that multiple factors influence food choice in maturing children and adults, involving group (culture, tribe, family, or clique) beliefs about foods' healthfulness, taste, morality, and status, as well as individual experience with particular foods.[39] Rozin points to the following three principles of learning as being especially important in establishing or changing people's food preferences.

Mere exposure is the phenomenon whereby simply being presented repeatedly with a neutral (or positive) stimulus, thereby becoming increasingly familiar with it, increases liking for it.[40] The mere exposure phenomenon occurs with a vast array of physical and social stimuli. Applied to food, it can explain why people prefer the foods with which they are most familiar.

Evaluative conditioning, also known as Pavlovian classical conditioning, involves associating a new, neutral stimulus with something that already has the power to elicit a positive (or aversive) autonomic response.[41] By repeated paired presentations, the new stimulus acquires the same power to elicit a positive (or aversive) response. In life, one often is introduced to new foods in the company of family and friends, in comfortable settings, and as parts of meals where other items on the menu are foods that one already knows and enjoys.

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36. *See* Susan A. Sullivan & Leann L. Birch, *Pass the Sugar, Pass the Salt: Experience Dictates Preference*, 26 DEV. PSYCHOL. 546, 546 (1990).

37. Shutts et al., *supra* note 34, at 420.

38. *Id.*

39. Paul Rozin, *The Integration of Biological, Social, Cultural, and Psychological Influences on Food Choice, in* THE PSYCHOLOGY OF FOOD CHOICE 19 (Richard Sheperd & Monique Raats eds., 2006).

40. Robert F. Bornstein, *Exposure and Affect: Overview and Meta-Analysis of Research, 1968–1987*, 106 PSYCHOL. BULL. 265, 265 (1989); Robert B. Zajonc, *Attitudinal Effects of Mere Exposure*, 9 J. PERSONALITY & SOC. PSYCHOL. 1, 1–2 (MONOGRAPH SUPP. 1968).

41. Rozin, *supra* note 39, at 27–28.

The new food becomes associated with those other elicitors, and acquires the ability to elicit the same positive reactions.

Social influence embodies a set of social psychological phenomena that induce the targets of influence to believe, feel, or do things regardless of whether they are inclined to.[42] The most relevant of these to the present discussion are the following.

> *Authority*: we yield more readily to requests and recommendations from those regarded as having expertise, legitimacy, and credibility—thus, children eat much of what parents and other adults direct them to eat.
>
> *Social proof*: we are persuaded by what others believe and what we see others do—thus, we are inclined to follow the lead of hosts in unfamiliar settings or cultures.
>
> *Liking:* we yield more readily to those we like—thus, we are more inclined to try a new or worrisome food when the suggestion comes from someone toward whom we have favorable feelings.
>
> *Commitment/Consistency*: we try to keep our behavior consistent with the verbal or behavioral acts we have previously performed in the presence of other people—thus, once we display certain food preferences, especially any having cultural significance, we tend to continue to eat those foods.

Importantly, learning about food is different from, and tends to be more powerful than, other learning. Research from an evolutionary perspective has demonstrated that food learning is not equipotential—that is, some things are learned more readily than others. Like other food choice phenomena, it involves selective biases and asymmetric sensitivities.[43] For example, research found that rats associated nausea with a new food after a single trial, but failed to associate nausea as readily with other stimuli (e.g., lights or sounds).[44] In addition, social signals about food may be particularly salient to human children because they rely on caregivers for food;[45] merely seeing an adult eat an unfamiliar food increases the likelihood a child will eat it.[46]

D. Biophilia

Humans have a strong affinity for the natural world, which E.O. Wilson termed *biophilia* and hypothesized to be innate.[47] A potent aspect of that pref-

42. *See generally* ROBERT B. CIALDINI, INFLUENCE: THE PSYCHOLOGY OF PERSUASION (Harper Collins rev. ed. 2006).

43. H. Clark Barrett & James Broesch, *Prepared Social Learning About Dangerous Animals in Children*, 33 EVOLUTION & HUM. BEHAV. 499, 499–501 (2012); John Garcia & Robert A. Koelling, *Relation of Cue to Consequence in Avoidance Learning*, 4 PSYCHONOMIC SCI. 123, 123–24 (1966).

44. *See, e.g.*, Garcia & Koelling, *supra* note 43.

45. Shutts et al., *supra* note 34, at 420.

46. Elsa Addessi et al., *Specific Social Influences on the Acceptance of Novel Foods in 2–5-Year-Old Children*, 45 APPETITE 264, 269 (2005).

47. EDWARD O. WILSON, BIOPHILIA 1 (1984); Edward O. Wilson, *Biophilia and the Conservation Ethic*, *in* THE BIOPHILIA HYPOTHESIS 31 (Stephen R. Kellert & Edward O. Wilson eds., 1993); Paul Rozin et al., *Preference for Natural: Instrumental and Ideational/Moral Motivations, and the Contrast Between Foods and Medicines*, 43 APPETITE 147, 148 (2004) [hereinafter Rozin et al., *Preference for Natural*].

erence involves foods, and that preference is less about reasoning and more about instinctive choices.

Studies of judgments of "naturalness" of food by average Americans reveal systematic patterns.[48] People strongly prefer foods that have been subjected to less processing, which correlates to less human intervention. (Human contact is felt to reduce the healthfulness of those foods with which contact has occurred.) Revealingly, this preference is felt more strongly with foods (which have a longer and deeper evolutionary history) than it is with medicines.[49] Perceptions of naturalness are not compromised by mixing natural entities or by natural processes such as freezing or crushing. But if a natural substance is transformed, such as by adding substances to it (e.g., adding sugar to tomato paste), it is viewed less favorably, even if that transformation is later reversed. Thus, process dominates content.[50] More familiar foods are also perceived to be more natural (though, in biological terms, one obviously has nothing to do with the other). The biggest decrease in judgments of the naturalness of foods is produced by gene insertions.[51]

Thus, judgments of naturalness do not reflect biological reality so much as they reflect shared perceptions and preprogrammed intuitions. Average Americans rate a cocker spaniel—despite its having been bred for centuries to express certain traits—as more natural than a plant or animal modified with a single gene insertion.[52] Fear that a gene from a catfish would make a tomato taste fishy seems foolish to a geneticist, but strikes the intuition of average humans as being well within the realm of possibility.[53] Potential consumers from the Judeo-Christian tradition might be aware that God is reported to have prohibited as impure certain agricultural and manufacturing practices, such as blending textiles, mixing seeds in the same field, or cross-breeding cattle,[54] and extend those prohibitions to transgenic foods.[55]

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48. Paul Rozin, *The Meaning of "Natural": Process More Important than Content*, 16 PSYCHOL. SCI. 652, 652 (2005) [hereinafter Rozin, *Meaning of "Natural"*]; Rozin et al., *Preference for Natural*, *supra* note 47, at 147.

49. Rozin et al., *Preference for Natural*, *supra* note 47, 148–49.

50. Rozin, *Meaning of "Natural"*, *supra* note 48, at 653.

51. *Id.*

52. *Id.* at 657. On the other hand, horizontal gene transfer between two species has been found to occur in nature. *See* Sara Knapton, *Butterflies Steal DNA of Zombie Wasps in Natural Genetic Modification*, TELEGRAPH (Sept. 17, 2015), http://www.telegraph.co.uk/news/earth/wildlife/11872099/Butterflies-steal-DNA-of-zombie-wasps-in-natural-genetic-modification.html.

53. WILLIAM K. HALLMAN ET AL., AMERICANS AND GM FOOD: KNOWLEDGE, OPINION AND INTEREST IN 2004, at 5, (2004), http://www.foodprocessing.com/assets/Media/MediaManager/RutgersGMFoodStudy.pdf.

54. "You shall not breed together two kinds of your cattle; you shall not sow your field with two kinds of seed, nor wear a garment upon you of two kinds of material mixed together." *Leviticus* 19:19 (New American Standard).

55. Inserting genes from certain food sources, such as pigs, into other food sources would also violate some religions' prohibitions against eating specific foods, alone or in combination with other foods. *See* Andrew J. Knight, *Perceptions, Knowledge and Ethical Concerns with GM Foods and the GM Process*, 18 PUB. UNDERSTANDING SCI. 177, 179 (2009).

E. Concept Formation and Cognitive Heuristics

Humans organize our understanding of the complex world using concepts, grouping objects and events into conceptual categories, relating those categories to each other, and attaching valences to the categories.[56] Put simply, we tend to think in categories. In addition, we often rely on cognitive heuristics—evolutionarily adaptive mental shortcuts—when making decisions.[57] Decisions regarding food choices are especially susceptible to reliance on categorization and cognitive heuristics because of the quantity and complexity of health-related information.[58] For example, some individuals might think that healthiness is related to the fat content of food, while others think it is about "good" versus "bad" types of fat, and still others might believe fat is largely irrelevant, thinking that healthiness is connoted by carbohydrates. Other individuals and cultures implicitly regard healthfulness in terms of portion sizes.[59]

Similarly, foods tend to be classified into few and simple categories: good or bad, safe or unsafe, healthy or not, tending toward all-or-none judgments (dose insensitivity), rather than being conceptualized into more categories with finer gradations and more complex interrelationships.[60] And we often make quick, intuitive decisions about whether a particular food is unsafe and to be avoided, based on indirect evidence or heuristic cues such as superficial features, simple associations, and feelings.[61]

To group things into different categories is also to set boundaries between those groupings. Beliefs about what foods, animals, and plants are and what they are not constitute some of the most basic conceptualizations we have. Violating these boundaries often produces anxiety as our mental blueprint of the world is challenged. For example, people in Western cultures recoil at the thought of munching on insects or dining on animals commonly regarded as pets. Things that do not fit the basic categories defining our view of reality appear anomalous and threatening. Taboos—including, of course, food taboos—represent categories for which boundary violations can be felt so strongly that they provoke fear, anger, disgust, and even a desire to punish transgressions.[62]

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56. SUSAN FISKE & SHELLEY TAYLOR, SOCIAL COGNITION 139 (1984); Eleanor H. Rosch, *Natural Categories*, 4 COGNITIVE PSYCHOL. 328, 348–49 (1973).

57. DANIEL KAHNEMAN ET AL., JUDGMENT UNDER UNCERTAINTY: HEURISTICS AND BIASES 20 (1982); Daniel Kahneman, *A Perspective on Judgment and Choice: Mapping Bounded Rationality*, 58 AM. PSYCHOL. 697, 707 (2003).

58. *See* Paul Rozin, *Human Food Intake and Choice: Biological, Psychological, and Cultural Perspectives*, *in* FOOD SELECTION: FROM GENES TO CULTURE 9 (H. Anderson et al. eds., 2002).

59. *See* Paul Rozin et al., *The Ecology of Eating: Smaller Portion Sizes in France than in the United States Help Explain the French Paradox*, 14 PSYCHOL. SCI. 450, 450 (2003).

60. Paul Rozin et al., *Lay American Conceptions of Nutrition: Dose Insensitivity, Categorical Thinking, Contagion, and the Monotonic Mind*, 15 HEALTH PSYCHOL. 438, 438 (1996).

61. *Id.*

62. *See generally* MARY DOUGLAS, PURITY AND DANGER: AN ANALYSIS OF CONCEPTS OF POLLUTION AND TABOO (1966).

F. Magical Rules

The human mind's routine efforts to understand the world and to make beneficial choices in the face of what could otherwise be paralyzing complexity go beyond hypervigilance, rigid categorizations, and heuristic shortcuts. Some of our cognitive processes operate at such a distance from rational thinking that researchers have dubbed them *magical rules* or *magical thinking*—meaning beliefs that follow principles that cannot be justified by reason or systematic observation.[63]

Magical thinking takes many forms. Typically, it has us misperceiving the nature of objects and events in the world and misconstruing causal connections among them. The most familiar examples are found in superstitious beliefs, taboos, and rituals. But more mundane examples populate our everyday lives. Among these are the tendency to overperceive agency, to overperceive correlation and causation based on a few data points, and to perceive objects and events having superficial similarity as sharing more essential properties. For example, sailors traditionally enforced norms against whistling out of fear that whistling stirs up excessive winds. Whistling is superficially similar to wind and, no doubt, instances had been observed where a storm had been preceded by a sailor whistling at sea.

As applied to food, the "law of similarity" is a potent intuition that rational thought does not easily overthrow.[64] For example, research participants are loath to eat fudge shaped like feces. Other magical beliefs that obey the law of similarity include the belief that the water content of foods eaten should equal the water content of our own bodies, or that foods whose shapes resemble certain organs are beneficial for those organs (e.g., heart-shaped leaves curing heart disease).[65]

Another important magical rule pertaining to food is: "once in contact, always in contact."[66] As noted earlier, humans perceive objects and events in terms of categories, and membership in a category is determined by an item's essence. Essences are intuited to transfer from one object to another, and that

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63. MATTHEW HUTSON, THE 7 LAWS OF MAGICAL THINKING: HOW IRRATIONAL BELIEFS KEEP US HAPPY, HEALTHY, AND SANE 2 (2012); GEORGE SERBAN, THE TYRANNY OF MAGICAL THINKING 10–11 (1982).

64. *See* Carol Nemeroff & Paul Rozin, *The Contagion Concept in Adult Thinking in the United States: Transmission of Germs and of Interpersonal Influence*, 22 ETHOS 158, 158–59 (1994); Paul Rozin & April E. Fallon, *A Perspective on Disgust*, 94 PSYCHOL. REV. 23, 30 (1987); Paul Rozin & Carol Nemeroff, *The Laws of Sympathetic Magic: A Psychological Analysis of Similarity and Contagion*, *in* CULTURAL PSYCHOLOGY: ESSAYS ON COMPARATIVE HUMAN DEVELOPMENT 205, 206 (James W. Stigler et al. eds., 1990); Paul Rozin et al., *Operation of Laws of Sympathetic Magic*, *supra* note 33, at 703.

65. Marjaana Lindeman et al., *Assessment of Magical Beliefs About Food and Health*, 5 J. HEALTH PSYCHOL. 195, 197 (2000).

66. Ahalya Hejmadi et al., *Once in Contact, Always in Contact: Contagious Essence and Conceptions of Purification in American and Hindu Indian Children*, 40 DEVELOPMENTAL PSYCHOL. 467, 468 (2004).

transfer of essence (contamination) is sensed as being difficult or impossible to reverse.[67]

By the age of eight, the great majority of humans acquire sensitivity to the possibility that food can become contaminated, and they find the prospect of ingesting such food or drink noxious.[68] Sensitivities to contagious essence, along with conceptions of purity, include moral and symbolic contamination as well as biological and chemical. Contagious essence occurs when two objects come into contact or are in proximity. Each object's essence exerts a continuing influence on the other, even after the contact has ended, with harmful influences predominating over beneficial ones.[69] For example, food is perceived as contaminated if it is stirred with a brand new, clean comb, or a new, clean, never-used flyswatter.[70]

Purification, if possible at all, also follows magical rules. Sometimes prayer is felt to reverse some kinds of contamination.[71] Contamination sensitivity is a phenomenon found only in humans, and reflects the workings of our cognitive machinery. It has been observed by researchers at least as long ago as the nineteenth century.[72]

II. GMOs AND THE PSYCHOLOGY OF FOOD: A PERFECT STORM

The advent and development of GM foods has sailed into a perfect storm of cognitive, emotional, and evolutionary rough waters. Because of our evolved psychology for evaluating potential foods, our reception of GM foods is, and should have been expected to be, unlike our reception of other technologies. The very notion of altering a food source by moving genes from one species to another invites aversion by the hypervigilant behavioral immune system, inclined as it is to shun foods that are perceived as unnatural or unfamiliar, or that appear contaminated physically or symbolically, or that have

67. Hejmadi et al., *supra* note 66, at 468; Nemeroff & Rozin, *supra* note 64, at 159; Carol Nemeroff & Paul Rozin, *The Makings of the Magical Mind: The Nature and Function of Sympathetic Magical Thinking*, *in* IMAGINING THE IMPOSSIBLE: MAGICAL, SCIENTIFIC, AND RELIGIOUS THINKING IN CHILDREN 1, 3 (Karl S. Rosengren et al. eds., 2000); Rozin & Nemeroff, *supra* note 64.

68. Hejmadi et al., *supra* note 66.

69. Nemeroff & Rozin, *supra* note 64, at 159; *see* Gregg E.A. Solomon & Nicholas L. Cassimatis, *On Facts and Conceptual Systems: Young Children's Integration of Their Understandings of Germs and Contagion*, 35 DEVELOPMENTAL PSYCHOL. 113, 113 (1999).

70. Paul Rozin et al., *Family Resemblance in Attitudes to Food*, 20 DEVELOPMENTAL PSYCHOL. 309, 310–11 (1984); Paul Rozin et al., *Individual Differences in Disgust Sensitivity: Comparisons and Evaluations of Paper-and-Pencil versus Behavioral Measures*, 33 J. RES. PERSONALITY 330, 338 (1999); Paul Rozin et al., *Operation of the Sympathetic Magical Law of Contagion in Interpersonal Attitudes Among Americans*, 27 BULL. PSYCHONOMIC SOC'Y 367, 367 (1989).

71. *See* Kathryn A. Johnson et al., *Matzah, Meat, Milk, and Mana: Psychological Influences on Religio-Cultural Food Practices*, 42 J. CROSS-CULTURAL PSYCHOL. 1421, 1427 (2001).

72. *See* 2 EDWARD B. TYLOR, PRIMITIVE CULTURE: RESEARCHES INTO THE DEVELOPMENT OF MYTHOLOGY, PHILOSOPHY, RELIGION, ART AND CUSTOM 388 (New York, Gordon Press 1974) (1871).

been subjected to "unnatural" transformations.[73] We intuit magical rules that caution us about "transfer of essence." The more vulnerable to disease people feel generally, the more averse they are to GM foods.[74] By contrast, GM products other than foods, notably medications, are much less likely to be intuitively shunned.[75] Such findings underscore the notion that *food is different*.

Moreover, the greater the phylogenetic distance between borrowed genes and the engineered product into which they are inserted, the greater the probability and magnitude of aversion. People are much more concerned about inserting animal genes into a plant than inserting genes from one plant into another, and view the former as more "unnatural."[76] The issue of phylogenetic distance has also been discussed in moral, ethical, and conceptual terms,[77] which tend to parallel the psychological reactions.

These findings have implications for the kinds of GMOs that will be less versus more troubling to the public. One implication is that products crossing narrower evolutionary divides will trigger less resistance. (See Table 1 below.) Relatedly, the farther from humans a GMO product is, the more tolerant humans appear to be of genetic manipulations of (within) that species. People are less comfortable with, less likely to approve of, less willing to eat, and more willing to pay a premium to avoid animal-based GM foods compared to plant-based GM foods.[78] Further, people are willing to pay more to avoid salmon that itself has undergone genetic modification than to avoid salmon that has been fed plant-based food that was genetically modified.[79]

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73. Shaw, *supra* note 5, at 280 (finding that people noted the "unnaturalness" of moving genes across species barriers); Knight, *supra* note 55, at 187 (finding that people did not view genetic modification as a mere extension of traditional breeding methods).

74. Pavol Prokop et al., *Disease-Threat Model Explains Acceptance of Genetically Modified Products*, 46 PSIHOLOGIJA 229 (2013).

75. Melanie Connor & Michael Siegrist, *Factors Influencing People's Acceptance of Gene Technology: The Role of Knowledge, Health Expectations, Naturalness, and Social Trust*, 32 SCI. COMM. 514, 515–17, 529 (2010); Lucia Savadori et al., *Expert and Public Perception of Risk from Biotechnology*, 24 RISK ANALYSIS 1289, 1290 (2004).

76. Knight, *supra* note 55, at 184–86; Darryl Macer & Mary Ann Chen Ng, *Changing Attitudes to Biotechnology in Japan*, 18 NATURE BIOTECHNOLOGY 945, 947 (2000). This pattern was seen for scientists as well as the general public. *Id.*

77. *See generally* Bjorn K. Myskja, *The Moral Difference Between Intragenic and Transgenic Modification of Plants*, 19 J. AGRIC. & ENVTL. ETHICS 225 (2006) (discussing the ethical and moral aspects of creating intragenic and transgenic organisms); Kaare M. Nielsen, *Transgenic Organisms—Time for Conceptual Diversification?*, 21 NATURE BIOTECHNOLOGY 227 (2003) (arguing for a reconceptualization of GMOs to improve public understanding of GMOs and guide further GMO research).

78. Dietrich & Schibeci, *supra* note 15, at 382–84; Lusk et al., *supra* note 12, at 38; Marques et al., *supra* note 15, at 607; HALLMAN ET AL., *supra* note 53, at 7; William K. Hallman & Helen L. Aquino, Consumer Perceptions of Genetically Modified Food 11 (July 27–30, 2003) (paper presented at the annual meeting of the American Agricultural Economics Association), http://core.ac.uk/download/pdf/7062299.pdf; Kaneko & Chern, *supra* note 7, at 13–15; THOMSON REUTERS, *supra* note 2, at 5

79. Kaneko & Chern, *supra* note 7, at 14–15. The U.S. Food and Drug Administration has recently approved GM salmon, the first GM animal to be approved for consumption. *See FDA Has Determined That the AquAdvantage Salmon Is as Safe to Eat as Non-GE Salmon*, U.S. FOOD & DRUG ADMIN. (Nov. 19, 2015), http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm472487.htm.

Table 1. Proposed categories for organisms currently designated 'transgenic' or 'genetically modified'

Categories	Source of genetic modifications	Genetic variability via conventional breeding	Genetic distance
Intragenic	Within genome[a]	Possible	Low
Famigenic	Species in the same family[b]	Possible	↓
Linegenic	Species in the same lineage[c]	Impossible	
Transgenic	Unrelated species[d]	Impossible	
Xenogenic	Laboratory-designed genes[e]	Impossible	High

[a]From directed mutations or recombinations; the extent of modification also reflects those arising in classical, selection-based breeding.
[b]Taxonomic family; the extent of modification also reflects those arising from applying cellular techniques in classical breeding.
[c]Phylogenetic lineage; recombination of genetic material beyond what can be achieved by classical breeding methods.
[d]Contains recombined DNA from unrelated organisms. Reflects the genetic composition of most GMOs commercialized today.
[e]For which no naturally evolved genetic counterpart can be found or expected (for example, synthetic genes and novel combinations of protein domains from various species).

Table 1. Categories of Transgenic and Genetically Modified Organisms by Phylogenetic Distance. From Kaare M. Nielsen, *Transgenic Organisms—Time for Conceptual Diversification?*, 21 NATURE BIOTECHNOLOGY 227 (2003). Table reproduced by permission of Nature Publishing Group. Unauthorized use not permitted.

When GMOs are perceived to violate boundaries that seem natural to us, it is not surprising that they induce discomfort and rejection.[80] Indeed, the expected impact of such boundary violations on an average person is so clear to anti-GMO activists that whimsical depictions of boundary violations are frequent choices for posters and billboards created to arouse the public. (See Figure 1 below.) The very nature of GMOs makes such attacks unusually easy to conceive and exceptionally resonant.

Many of the processes of influence and learning described in Section I are managed by humans acting in groups, including religious, governmental, educational, healthcare, business, scientific, and other organizations and institutions. Studies concerned specifically with factors that influence acceptability of GM foods have found that trust in institutions plays an important role.[81]

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80. Brian P. Bloomfield & Bill Doolin, *Symbolic Communication in Public Protest Over Genetic Modification: Visual Rhetoric, Symbolic Excess, and Social Mores*, 35 SCI. COMM. 502, 520 (2013).

81. *See* Connor & Siegrist, *supra* note 75, at 518, 521; Lynn J. Frewer & Susan Miles, *Temporal Stability of the Psychological Determinants of Trust: Implications for Communication About Food Risks*, 5 HEALTH, RISK & SOC'Y 259, 260 (2003); Jan Gutteling et al., *Trust in Governance and the Acceptance of Genetically Modified Food in the Netherlands*, 15 PUB. UNDERSTANDING SCI. 103, 108–09 (2006); Marques et al., *supra* note 15, at 610; Andrew Papadopoulos et al., *Enhancing Public Trust in the Food Safety Regulatory System*, 107 HEALTH POL'Y 98, 101 (2012); Michael Siegrist, *A Causal Model Explaining the Perception and Acceptance of Gene Technology*, 29 J. APPLIED SOC. PSYCHOL. 2093, 2094 (1999); Wanki Moon & Siva Balasubramanian, A Multi-Attribute Model of Public Acceptance of Genetically Modified Organisms 2 (Aug. 5–8, 2001) (paper presented at the annual meeting of the American Agricultural Economics Association), http://purl.umn.edu/20745.

Figure 1. Illustrative Anti-GMO Poster
Figure reproduced by permission of Greenpeace.
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Trust in government has been found to be especially relevant to public acceptance of GM foods. Dutch respondents with higher trust in government had more positive attitudes to and higher acceptance of GM foods, and were less likely to have signed a petition or joined a protest against GM developments.[82] People in the United States and United Kingdom who had more trust that the relevant regulatory authorities had adequate rules and regulations for GM foods were more likely to hold favorable views of GM foods and were less likely to think GM foods posed health risks.[83] Similarly, Australians who had higher trust in regulators and scientists had more positive attitudes toward GM foods.[84] People who had more generalized trust in institutions perceived fewer risks and more benefits of GM foods[85] and had more favorable views and greater acceptance of GM foods.[86] Unsurprisingly, people who had more negative views of agribusiness and who saw agribusiness as the primary beneficiaries of genetic manipulation tended to have more negative views of GM foods.[87]

To make an inherently difficult situation worse, some of the organizations involved in producing GM foods have not always acted in ways that would

82. Gutteling et al., *supra* note 81, at 110.

83. Moon & Balasubramanian, *supra* note 81, at 9, 11–12.

84. Marques et al., *supra* note 15, at 610.

85. Connor & Siegrist, *supra* note 75, at 521–33.

86. *Id.*; Peters et al., *supra* note 7, at 202. People who had higher trust in NGOs and environmental organizations, however, had more negative views of GM foods. Gutteling et al., *supra* note 81, at 108–09; Marques et al., *supra* note 15, at 610.

87. Moon & Balasubramanian, *supra* note 81, at 8–9.

lead the public to view them as transparent, trustworthy, and benevolent corporate citizens concerned with the health, safety, and well-being of consumers and the environment. Numerous studies of consumers' perceptions and attitudes about institutions involved in food production have found industry near the bottom of the hierarchy of trusted institutions.[88]

Consider one prominent example: the corporate investment in preventing the adoption of mandatory labeling laws in the United States.[89] Such actions create the appearance (and reality) of businesses trying to hide information from the public, preventing consumers from being able to make the choices they might wish to make, and working to defeat prevailing public opinion. A better strategy for promoting public distrust and dislike would be hard to conceive.[90] Moreover, hiding the provenance of the content of food allows consumers to believe they are avoiding GM foods when in fact much of what they eat already is genetically modified or consists of animals that have been fed GM crops.[91] Ironically, then, preventing labeling keeps consumers from becoming more aware of and familiar with the GM foods they already are eating, presumably liking, and not being harmed by.

Public wariness of food manufacturers is exacerbated when regulatory institutions are, or are perceived to be, weak or ineffective—whether from inadequate resources, regulatory capture, lack of independence, or a generalized decline in public trust in government.[92] The resulting perception of insufficiently robust policing of the food industry contributes further to the probability that consumer aversion to GM foods will persist.[93] A review of Canadian research found, "The public expects a safe food system and they lack con-

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88. Montserrat Costa-Font et al., *Consumer Acceptance, Valuation of and Attitudes Towards Genetically Modified Food: Review and Implications for Food Policy*, 33 FOOD POL'Y 99, 104 (2008); John T. Lang, *Elements of Public Trust in the American Food System: Experts, Organizations, and Genetically Modified Food*, 41 FOOD POL'Y 145, 151 (2013); John T. Lang & William K. Hallman, *Who Does the Public Trust? The Case of Genetically Modified Food in the United States*, 25 RISK ANALYSIS 1241, 1241 (2005). Regulators also received low ratings; by contrast, scientists, universities, and medical professionals received significantly higher ratings on trust, competence, and honesty.

89. *See supra* notes 9–10 and accompanying text. Within months of the effective date of Vermont's law requiring labeling of GM food products, however, several major food companies announced they would begin labeling their products nationwide because it would be too complicated and expensive to have different labels for different states. *See* Gasparo & Bunge, *supra* note 10; Charles & Aubrey, *supra* note 10. Notably, Campbell Soup Company is the only large food company to date to publicly support federal requirements and standards for mandatory labeling. Charles & Aubrey, *supra* note 10; Candice Choi & Mary Clare Jalonick, *General Mills Is Embracing New GMO Law in Vermont: Many in Industry Are Opposed to Mandatory GMO Labeling Law Beginning This Summer*, U.S. NEWS (Mar. 18, 2016), http://www.usnews.com/news/business/articles/2016-03-18/general-mills-to-label-products-with-gmos-ahead-of-vt-law.

90. Lynn Frewer, *Societal Issues and Public Attitudes Towards Genetically Modified Foods*, 14 TRENDS FOOD SCI. & TECH. 319, 319 (2003); Lang & Hallman, *supra* note 88.

91. *See* HALLMAN ET AL., *supra* note 53, at 1, 3–4; Hallman & Aquino, *supra* note 78, at 8–9.

92. Gregory N. Mandel, *Gaps, Inexperience, Inconsistencies, and Overlaps: Crisis in the Regulation of Genetically Modified Plants and Animals*, 45 WM & MARY L. REV. 2167, 2167 (2004).

93. *See* Costa-Font et al., *supra* note 88, at 104; Frewer, *supra* note 90; Wouter Poortinga & Nick F. Pidgeon, *Trust in Risk Regulation: Cause or Consequence of the Acceptability of GM Food?*, 25 RISK ANALYSIS 199, 200 (2005). For suggestions on overcoming these deficiencies in relation to GM foods, see Mandel, *supra* note 1, at 50.

fidence in the current system. They desire increased scientifically transparent communication from a trusted source, a stronger public health presence, a coordinated food safety regulatory system, and increased access to inspection results."[94]

Genetically engineered foods are not merely another technological innovation among many. Human food choice and aversion are powerfully, yet flexibly, determined by our species' cognitive, social, developmental, and evolutionary psychology, especially as those are manifested through the behavioral immune system. In light of what is known about these systems, persistent anxiety about and resistance to GM foods cannot be viewed as surprising. Overcoming consumer resistance to GM foods is not insuperable, but in light of the deeper roots of resistance, and with a fuller understanding of the processes that bring about change in food preferences,[95] it becomes more clear why the path ahead is a challenging one for all.

94. Papadopoulos et al., *supra* note 81, at 98.

95. No manufacturer of consumer electronics would ignore the response of potential customers to a product's design. Those manufacturers would not declare a design to be efficient, effective, logical, powerful, safe, and so forth, and insist that prospective customers had to change their "irrational" reactions if some aspect of the product's design evoked consumer aversion. Yet that is, in essence, what GM food manufacturers have been doing. The practical question is whether a harmonious meeting of product and consumer is likely to be achieved more readily by changing the former or the latter.