

The Social Origins of Disgust

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Despite being perfectly nutritious, consuming bugs is considered gross in many cultures (Ruby, Rozin, and Chan 2015). This disgust reaction carries severe consequences. Considering the negative environmental impacts of the growing consumption of beef, poultry, and fish, the United Nations Food and Agriculture Organization has identified eating insects as a sustainable solution for maintaining protein-rich diets (van Huis et al. 2013), but the prevalent disgust reaction to this initiative presents a substantial hurdle. What is the function of such an irrational response, one that may continue to endanger the natural environment? Do people experience disgust toward insects because of perceived disease risks? Are people reacting to the reminder that they are eating an animal, in the same way that many people react negatively to eating a whole fish (with its head and eyes) compared to a fish fillet? We argue that social risks may instead be motivating this reaction. More broadly, moving beyond the example of entomophagy, we claim that disgust is much more deeply enmeshed in social and moral considerations than has been previously acknowledged.

The scientific study of disgust has been predominantly concerned with uncovering its ultimate adaptive purpose. Theories about the function of disgust abound, ranging from the abhorrence of disorder and ambiguity (Douglas 1966) to an existential recoiling from reminders of mortality and animality (Becker 1973; Goldenberg et al. 2001; Nussbaum 2004). However, a clear front-runner has emerged amongst these diverse proposals: Disgust evolved because it has helped humans to avoid physical contact with poisons, parasites, and pathogens. In this chapter, we propose an alternative to the recurrent claim that disgust evolved for the sole purpose of facilitating the avoidance of toxins and infectious disease (e.g., Chapman and Anderson 2012; Curtis 2011; Curtis and Biran 2001; Davey 2011; Rozin and Fallon 1987; Rozin, Haidt, and

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Fincher 2009; Schaller and Park 2011; Stevenson, Case, and Oaten 2009; Tybur et al. 2013). Because this paradigmatic idea posits a purely physical (i.e., non-social) reason for the existence of disgust, we refer to it as the “Physical Origins” hypothesis.

We do not deny that disease avoidance is a crucial element of disgust, but we believe that there is more to the story. We argue that a central component of the adaptive value of disgust lies in the motivation it provides for reducing contact with people who are considered to be deviant or marginalized, both for disease-related and reputation-related reasons (see Chudek and Henrich 2011, for a discussion of the adaptive function of social norms). We hereby introduce the “Social Origins” hypothesis as a crucial addition to the Physical Origins hypothesis to provide a more complete evolutionary account of disgust. According to our hypothesis, disgust originated largely as a functional response for preventing contact with foreigners or people acting in non-normative ways. This response serves a dual adaptive purpose: reducing human-borne illnesses and maintaining reputational status within one’s social group, either separately or simultaneously. Therefore, while avoiding pathogens is a crucial component of a full explanation of disgust’s origins and functions, we argue that simple disease avoidance was not the sole or even the primary driver of the evolution of disgust in humans.

The Physical Origins Hypothesis

As the traditional story goes, disgust evolved solely to facilitate humans’ rejection of toxins and harmful microorganisms. Most scholars (including most contributors to this volume) generally agree that people have developed the ability to detect reliable indicators of poisons and pathogens, that these indicators of poisons and pathogens are the primary stimuli that trigger feelings of revulsion, and that disgust thereby affords direct protection from poisons and pathogens. There are variations in this general claim. Some have argued that disgust originated primarily as a food rejection system preventing the consumption of harmful substances (Rozin, Haidt, and McCauley 2008). Others have proposed that disgust affords the avoidance of all kinds of infection, orally transmitted or otherwise (Curtis 2014; Oaten, Stevenson, and Case 2009). Still others have claimed that disgust is the product of the hominid entanglement of previously separate, phylogenetically ancient capacities to avoid consuming poisonous toxins and to avoid bodily contact with pathogens (Kelly 2011). Despite the meaningful differences between these theories, all assert that dangerous forms of matter comprise the core elicitors of

disgust. In other words, while other people (outgroup members or moral deviants) sometimes evoke disgust, the reigning belief is that disgust has been recently co-opted to respond to these auxiliary social elicitors, rather than social concerns being a crucial factor in the initial evolution of the disgust response. We therefore place these theories under a single umbrella.

The Physical Origins hypothesis is intuitively convincing. The typical facial expression associated with disgust (the “gape face”) is adaptively suited for oral rejection (Darwin 1872/1998). There are overlapping neural and physiological mechanisms underlying disgust and distaste (see Chapman and Anderson 2012). Previous associations between nausea and specific food flavors are difficult to break, even if people know that their nausea has a different cause (e.g., chemotherapy; Bernstein 1978, 1994). Finally, many widespread elicitors of disgust (e.g., bodily fluids) are reliably associated with the potential transmission of parasites and pathogens (Curtis, Aunger, and Rabie 2004). Indeed, we agree that disgust is intimately tied to avoidance of toxins and especially disease, but we depart from advocates of the Physical Origins hypothesis by doubting this to be the primary function of disgust.

Why Pathogen Avoidance Is Not Sufficient to Explain Disgust

Perhaps surprisingly, given such strong endorsements of the Physical Origins hypothesis, there is limited empirical evidence of a robust relationship between disgust and disease. While some studies have indicated a relation between disgust sensitivity and the avoidance of contaminants (e.g., Deacon and Olatunji 2007), others have failed to find any association between disgust sensitivity and increased health outcomes (e.g., de Barra, Islam, and Curtis 2014). Some research has shown that the experience of disgust is triggered by stimuli that indicate disease threats (Curtis, Aunger, and Rabie 2004), but other research suggests that disgust does not always reliably motivate behavioral tendencies to selectively avoid disease-ridden stimuli. For example, disgust does not lead people to dispose of stool properly or to clean one’s hands after defecating, even though these are the main causes of bacterial transmission and diarrheal illness (Curtis, Cairncross, and Yonli 2000). In addition, some characteristic disgust elicitors that are generally assumed to be carriers of pathogens (particularly putrid meat) serve as important sources of nutrition for many traditional hunter-gatherer societies and do not actually pose significant disease risks when correctly prepared (Speth 2017). Fermentation is a widespread method of food preparation and preservation, and foods such as cheese, kimchi, and

kæstur hákarl (fermented shark) can carry dietary benefits and are considered delicious rather than disgusting for people who grow up eating them. Indeed, the line between dangerous pathogen and helpful bacteria can be murky, as a growing body of literature suggests that the human microbiome (i.e., bacteria living inside the human body) is critical for many aspects of health (e.g., Kaplan et al. 2015; Turnbaugh et al. 2009; Turnbaugh et al. 2006).

It is also unclear that disgust is crucial for avoiding contact with non-social disease vectors. Instead, other emotions – particularly fear – may provide the requisite mechanisms for avoiding contaminants and poisons. For example, although little is known about the cognitive and emotional underpinnings of food neophobia (an avoidance of unfamiliar foods that is particularly prominent in children between 2 and 6 years of age), current research suggests that food neophobia is associated with increased pulse, galvanic skin response, and respiration – and thus may be driven largely by fear and anxiety rather than disgust (Lafraire et al. 2016; Raudenbush and Capiola 2012). Humans may additionally have capacities to detect signs of illness from physical cues without routing through disgust. In one study, people were able to differentiate between individuals injected with either an endotoxin or saline by just looking at photographs and smelling body odor samples taken from those individuals just two hours post-injection (Regenbogen et al. 2017).

Moreover, many species have otherwise solved the widespread evolutionary problem of evading the threat of pathogens and parasites without obviously necessitating the emotion of disgust (Curtis, de Barra, and Aunger 2011; Hart 1990; Loehle 1995). For instance, many other mammals, including ungulates like sheep, have evolved mechanisms for avoiding contact with feces (e.g., selective foraging; Hutchings et al. 1998). Even tadpoles avoid swimming near diseased conspecifics (Kiesecker et al. 1999). These highly functional forms of behavioral avoidance exist despite there being no easily identifiable manifestation of disgust in these non-human animals. Because humans did not obviously face qualitatively different pressures to avoid infection, this raises the possibility that additional, unique survival pressures precipitated the evolution of disgust in humans.

Furthermore, developmental data can serve to evaluate functional explanations that have been constructed primarily on the basis of data about their adaptiveness in the adult end-state. This approach has been undertaken to demonstrate that most threat-detection responses develop at ages that are appropriately calibrated to the functional problems they have evolved to solve

(Boyer and Bergstrom 2010). Appealing to this logic, we argue that the existing developmental evidence is largely inconsistent with a Physical Origins account (also see Rottman 2014). In particular, humans are at the greatest risk of infection during the first five years of life, when communicable diseases such as pneumonia and diarrhea are the leading causes of death around the world (Bryce et al. 2005). Therefore, if disgust reactions evolved to prevent infection, adaptationist views should predict that this emotion would be most robust in early childhood, after weaning and before the immune system has matured. However, existing data suggest that the development of disgust and the avoidance of contaminants is slow and protracted, remaining underdeveloped during early childhood (Rozin and Fallon 1987). For example, when presented with two bowls of applesauce – one of which appears contaminated by a person’s sneeze and saliva – children rate the two bowls as equally delicious and are equivalently likely to eat both until the age of 5 (DeJesus, Shutts, and Kinzler 2015). Additionally, children do not avoid playing with individuals who appear to be sick until 6 years of age, when they begin to appreciate the underlying causes of physical illness (Blacker and LoBue 2016). This mismatch of developmental evidence and the adaptationist view that disgust emerged exclusively for pathogen avoidance suggests that additional selective pressures may contribute to the emergence of disgust (Rottman 2014).

If disgust is a distinctively human emotion, as many have claimed (Kelly 2011; Rozin, Haidt, and McCauley 2008), what was the relevant adaptive pressure in ancestral humans that precipitated the attainment of this trait? Some have emphasized humans’ omnivorous diet, and thus greater potential exposure to harmful food-borne parasites (Rozin and Fallon 1987). We are skeptical that this constitutes the full story, and instead suggest that changes in social structures may have been a more important evolutionary pressure. Prehistoric increases in the size and density of human groups intensified the risk of infection through contact with conspecifics (Côté and Poulin 1995; Schaller 2011), and indeed there is a correlation between heightened regional levels of parasite stress and heightened considerations of social group membership (Fincher and Thornhill 2012). In addition, this increased sociality led to an increased importance of monitoring social standing within groups, which included the need to preserve reputation by avoiding people who are perceived as undesirable social partners (Boehm 2012).

The Social Origins Hypothesis

As a complement to the Physical Origins hypothesis, we propose the Social Origins hypothesis. Our hypothesis garners support from research investigating social influences on children's contamination avoidance, early attention to others' food choices, the influence of socio-moral considerations on disgust responses, and the developmental trajectory of disgust. This idea brings additional theory and evidence to bear on the development of disgust and the problem of disease avoidance that have not been considered by the Physical Origins hypothesis.

Although most evolutionary accounts of disgust acknowledge that disgust is often evoked by social elicitors, we depart from the predominant view that the socio-moral components of disgust emerged as an incidental byproduct or bio-cultural exaptation of the original poison- and pathogen-avoidance functions (Kelly 2011; Rozin and Haidt 2013; Rozin, Haidt, and Fincher 2009). The burden of evidence to declare a trait a byproduct should be just as stringent as that required in declaring a trait an adaptation (Sosis 2009), and we do not believe that there is currently sufficient empirical support for this byproduct claim. Instead, we believe the weight of evidence suggests an adaptationist view, such that social elicitors are central to the genealogy of disgust in humans.

The Social Origins hypothesis breaks from the Physical Origins hypothesis in claiming that the proper domain of disgust (i.e., the subset of inputs and outputs that are presumed to have characterized the disgust response in ancestral environments; see Sperber and Hirschfeld 2004) is not primarily disease vectors, but other people – in particular, individuals who are deemed to be social outsiders. In other words, disgust may have evolved in large part as a mechanism for excluding individuals from ingroups through stigmatization and ostracism and for preventing contact with individuals who are members of social outgroups. Although these exclusionary behaviors can be motivated by the possibility of disease contagion, stigmatization also occurs when non-diseased ingroup members demonstrate that they will be inadequate cooperative partners or behave in non-normative ways, or are simply members of a less familiar or distant social group. Some have proposed that there is a dedicated domain-specific mechanism for avoiding individuals who carry signs that they may harbor infectious diseases (Kurzban and Leary 2001; Oaten, Stevenson, and Case 2011). However, we find the evidence to be more consistent with a theory in which all forms of stigmatization can elicit disgust, regardless of whether actual or perceived contagion risk is involved. Therefore, pathogens themselves are not

the stimuli that primarily trigger disgust; any indication of non-normative behavior or outgroup membership will suffice (Rottman and Young 2014).

Given widespread support for the Physical Origins hypothesis, we anticipate initial resistance to our Social Origins account. It is therefore important to note our acknowledgement of the explanatory power of the reigning consensus and to emphasize that our hypothesis is not meant as a replacement of the existing paradigm, but rather as an extension. The avoidance of pathogens has very likely been a crucial component of the evolution of disgust, but a narrow focus on this function has led scholars to neglect what we believe to be another necessary ingredient: social regulation. We therefore agree with hypotheses stating that disgust had multiple adaptive origins (Kelly 2011; Strohminger 2014; Tybur, Lieberman, and Griskevicius 2009; Tybur et al. 2013), but we disagree that its physical origins are necessarily primary.

Additionally, we point out that the Social Origins hypothesis also helps to explain findings that are puzzling from the lens of the Physical Origins hypothesis – such as providing a more coherent account for why disgust is universally entangled with social issues and why it is late to develop, as will soon be described in more detail. The Social Origins hypothesis also provides an explanation for why disgust fails to develop in individuals with deficits in sociality, but no more or less susceptibility to disease. In particular, the ability to recognize the disgust face is impaired in people with psychopathy (Kosson et al. 2002) and aversions to contaminated substances are lacking in people with autism (Kalyva et al. 2010).

Humans Harbor Disease: Where Physical Origins and Social Origins Overlap

As previously indicated, pathogen avoidance does not seem to constitute a sufficient selective pressure for the unique existence of disgust in the human species. Yet, it is clear that any account of disgust must acknowledge its intimate connection to pathogens (e.g., Curtis and Biran 2001; Oaten, Stevenson, and Case 2009). It is possible that this connection exists primarily because of the disease threats posed by interactions with other people. Though eating or drinking contaminated food and water is the source of many pathogen-borne illnesses, a host of other diseases (e.g., Norovirus) are transmitted from person to person, or across people through intermediaries such as food prepared by infected individuals or commonly touched items (e.g., doorknobs and subway poles in modern environments). Diseases carried by foreigners can be more dangerous than diseases present in one's home environment because of human immune

and behavioral adaptations to local threats, which leave the system unprepared to fight foreign parasites (Fincher and Thornhill 2012; Thompson 2005). Given the critical importance of avoiding disease, it seems plausible that multiple systems contribute to protect humans against a variety of illness – one system simply is not enough. Just as a first-aid kit contains multiple distinct remedies, humans need a multifaceted toolkit in order to promote health and survival, particularly in light of the immense variety of pathogen threats that humans face and the opaqueness of disease transmission. As such, the human toolkit includes both biological and social influences on behavior that both contribute to disgust’s protective function.

There is evidence that disgust may function to protect individuals from socially transmitted forms of illness, facilitating a “behavioral immune system” as a first line of defense against pathogens (Schaller and Park 2011). People who feel more susceptible to infection react more negatively toward foreigners (Faulkner et al. 2004; Navarrete and Fessler 2006), and disgust is experienced more weakly when considering ingroup members and kin, such as smelling the sweaty clothing of individuals perceived to be ingroup members (Reicher et al. 2016) or the dirty diapers of one’s own baby (Case, Repacholi, and Stevenson 2006). Additionally, disgust is triggered by people with facial deformities, which is sometimes (but not always) an indication of an underlying infectious disease (Ryan et al. 2012). Therefore, it seems that disgust is suitably calibrated for leading to the behavioral avoidance of individuals who may be carrying pathogens. This was likely a major selective pressure leading to the evolution of disgust in humans. However, we argue that socially transmitted diseases were not the sole stimuli that facilitated the natural selection of disgust. In general, people are avoided and stigmatized for a wide variety of reasons, and disgust may facilitate this avoidance both when contracting disease is likely and when it is not. Crucially, even when disgust has the effect of promoting health, it is likely that the nature of the stimulus being avoided is typically social rather than directly indicative of a disease threat.

Beyond Disease: Multifaceted Social Elicitors of Disgust

Certainly, avoiding human-borne diseases is very likely one of the adaptive problems that disgust has evolved to solve. However, disgust is not finely tuned for specifically driving the avoidance of humans who appear to harbor parasites and pathogens – it is also widely evoked by ideational and normative factors with no apparent relationship to health or the possibility of

disease transmission (Giner-Sorolla and Sabo 2016; Haidt et al. 1997; Rozin and Fallon 1987; Rozin, Haidt, and McCauley 2008). Even in cases when disgust is elicited by reminders of outgroup members (Ritter and Preston 2011) and by indications of outgroup encroachment on markers of ingroup identity (Cheon, Christopoulos, and Hong 2016), it is unlikely that this is consistently related to threats of potential infection. Individual differences in disgust sensitivity correlate with ethnocentric, xenophobic intergroup attitudes (Inbar, Pizarro, and Bloom 2009; Inbar et al. 2012; Terrizzi, Shook, and Ventis 2010), and this relation between interpersonal disgust and negative attitudes toward outgroup members is not fully accounted for by the actual possibility of disease or even anxiety about infection from a perceived disease risk (Hodson and Costello 2007). Other research has indicated that relations between individual differences in disgust sensitivity and outgroup prejudice may be partially driven by decreased inclinations to exhibit generalized social trust, and that disgust influences social tendencies even within ingroups (Aarøe, Osmundsen, and Petersen 2016). Overall, data are increasingly indicting that disgust is frequently elicited by a range of behaviors that are viewed as socially or morally deviant (Chapman et al. 2009; Tybur et al. 2013), despite the absence of any perceptible signs of disease.

The specific relation between disgust and morality is contentious. Some have argued that the association is spurious, being merely linguistic or an artifact of particular research designs (Kayyal et al. 2015; Nabi 2002; Royzman and Sabini 2001). Furthermore, despite high-profile studies that purported to demonstrate an effect of incidental disgust on moral evaluations (Schnall et al. 2008; Wheatley and Haidt 2005), meta-analyses and replications have generally disconfirmed this evidence (e.g., Case, Oaten, and Stevenson 2012; Johnson et al. 2016; Landy and Goodwin 2015). Despite these experimental inconsistencies, however, there remains sufficient evidence that certain aspects of moral cognition do rely on disgust, even when controlling for experimental artifacts and the potential risk of pathogen transmission (for reviews, see Chapman and Anderson 2013; Olatunji and Puncochar 2014).

Disgust may be predominantly linked to particular categories of immoral acts, such as those related to sexuality (Crawford, Inbar, and Maloney 2014), to violations of the body (Russell and Giner-Sorolla 2013), or to violations of purity (Haidt 2012; Horberg et al. 2009). Some have argued that these kinds of acts (particularly in the sexual domain) elicit moral disgust because they expose people to serious health risks. Thus, disgust became tied to sexuality as a

means of encouraging more “traditional” forms of sex that are both high-investment and low-risk (i.e., heterosexual monogamy) as a means of behavioral regulation (Inbar and Pizarro, 2016). However, patterns of moralization of non-traditional sexual behaviors do not appear fully commensurate with their health risks. For instance, in American society, monogamous homosexuality seems to be moralized to a much greater extent than promiscuous heterosexuality, which can carry a greater risk of STIs in addition to the risks associated with pregnancy (an enormous health risk that has only recently reduced in mortality among those with access to medical advances). Patterns of sexual taboo – including enormous differences in standards for men and women, despite equal risk of infection – therefore present a puzzle that has not previously been sufficiently explored. Additionally, the “sexual conservatism” account does not explain why disgust reactions are also elicited by other body-directed or purity-based violations, including suicide (Rottman, Kelemen, and Young 2014) and the desecration of nature (Frimer, Tell, and Haidt 2015). Therefore, even though some of the research linking disgust and morality may be confounded with the presence of pathogens (see Royzman et al. 2014), this does not seem to hold true in all cases. The non-redundancy between domains of disease and disgust is underscored by recent work showing that, upon being told that harmless and presumably disease-free actions (e.g., face-painting) are “disgusting” and “gross”, children become more likely to judge these actions as immoral (Rottman and Kelemen 2012; Rottman, Young, and Kelemen 2017). Because other forms of testimony (e.g., appeals to harm) are more powerful than disgust-based testimony (Rottman, Young, and Kelemen 2017), this evidence does not itself indicate that disgust has a special role in moralization, but it does demonstrate that disgust can be readily linked to morality despite an absence of obvious disease risk.

Several features of disgust make it well suited for judging particular immoral acts as wrong. For example, disgust generally promotes a different action tendency than related emotions like anger or fear, and the slow withdrawal that is uniquely characteristic of disgust may be ideal for conveying social disapproval without risking costs of fighting or fleeing. The disgust expression itself may be a highly effective tool for demonstrating moral condemnation of deviant individuals (Kelly 2011; Tybur, Lieberman, and Griskevicius 2009; Tybur et al. 2013). Indeed, the disgust face has been found to serve as a more powerful signal of principled moral concern than the anger face, which appears to others as being self-interested (Kupfer and Giner-Sorolla 2017). Furthermore, disgust exerts a more “inflexible” and enduring effect on moral

judgments than other moral emotions, such that it is relatively unaffected by mitigating factors (Piazza, Russell, and Sousa 2013; Russell and Giner-Sorolla 2011b) including eliminates intent (Russell and Giner-Sorolla 2011a; Young and Saxe 2011). Disgust is additionally associated with heightened beliefs about intransigent dispositional factors (Chakroff and Young 2015), like being evil (Brandt and Reyna 2011), animalistic (Haslam 2006), or contaminating (Cottrell and Neuberg 2005; Rozin, Millman, and Nemeroff 1986). Perhaps because of these unique characteristics of disgust, people report that it is more undesirable to be the recipient of moral disgust than to be a recipient of other moral emotions (Hutcherson and Gross 2011).

Food as Social Glue

Disgust also regulates social interactions outside the moral domain. This is particularly evident for eating behaviors, as food is steeped in social connotations. Though some food preferences emerge early in development and across cultures, including preferences for sweet and salty flavors and preferences for familiar foods (Birch 1990, 1999; Ventura and Mennella 2011), human eating behavior cannot be explained by these tendencies alone (Rozin 1999, 2005; Shutts, Kinzler, and DeJesus 2013). There is disagreement as to whether children need to learn what is *not* disgusting or inappropriate to consume – meaning they initially think that everything is inedible (Bloom 2004; Pinker 1997) – or whether they need to learn what *is* disgusting or inappropriate to consume – meaning their initial bias is to assume edibility (Rozin 1990; Rozin et al. 1986). However, there is consensus that food preferences and choices are extremely plastic, especially in early childhood (Birch 1999), and that socio-cultural learning is a key contributor to the development of food preferences (Galef 1996; Rozin, Haidt, and McCauley 2008; Shutts, Kinzler, and DeJesus 2013). There is ample evidence that social learning mechanisms, including attention to testimony and social modeling, are powerful guides to the eating behavior of infants and young children (Addessi et al. 2005; Birch 1999; Cruwys, Bevelander, and Hermans 2015; Hendy and Raudenbush 2000; Lumeng et al. 2008; Wertz and Wynn 2014).

The food choices of potential cooperative partners and social ingroup members are particularly salient to children early in development (Cashdan 1998; Shutts, Kinzler, and DeJesus 2013), such that infants and young children preferentially attend to those who speak their native language (Shutts et al. 2009) and prosocial individuals (Hamlin and Wynn 2012) in the domain of food selection. Even babies expect that food preferences should be shared only by those with

social ties, such that they look longer (indicating a violation of expectation) when a third party's positive preference for a particular food is not shared by an affiliative partner or ingroup member, but demonstrate the opposite pattern when viewing two people who appear to dislike each other or who speak in different languages (Liberman et al. 2016).

Are food preferences socially learned because different local ecologies present distinct arrays of poisonous or disease-ridden foods, and social partners are likely to be the best source of information about what is safe to eat in one's local context? This is likely to be partially true (Henrich and Henrich 2010). However, we argue that another important reason for social learning in the food domain is to develop a preference for foods that are socially acceptable to eat within one's local cultural group, thus acquiring honest signals of group membership (see Cohen 2012; Henrich 2009). Children frequently gain acquired tastes even for substances that are innately aversive, such as capsicum (Rozin and Schiller 1980; see Galef 1989, for related findings in rats). Although some food taboos are related to health or safety concerns (Fessler and Navarrete 2003; Henrich and Henrich 2010), this is not always the case, and overall taboos seem to exist in large part to provide social identities and create group boundaries (Kelly and Morar, in press; Meyer-Rochow 2009; Rozin and Siegal 2003). This explains why adults form disgust responses toward foods they begin to avoid for moral reasons but not toward foods they begin to avoid for health-related reasons (Fessler et al. 2013; Rozin, Markwith, and Stoess 1997). Even avoidance of contaminated foods can be influenced by group membership. Although 3–4 year-olds do not differentiate between clean and contaminated foods presented without social group information, they avoid foods that appear to be contaminated when the actor who contaminates them speaks a foreign language (DeJesus, Shutts, and Kinzler in preparation).

In addition to social considerations driving food preferences, food choices also influence social evaluations. By five years of age, children negatively evaluate the consumption of unconventional foods (e.g., hot dogs with chocolate syrup poured on top, banana peels), nonfoods (e.g., grass), and “core” disgust elicitors (e.g. hair, insects), as well as the people who eat those foods, and are more likely to assign conventional foods (e.g., apples, milk with chocolate syrup) to cultural ingroup members and disgust elicitors (e.g., insects) to cultural outgroup members (DeJesus, Gerdin, Sullivan, and Kinzler under review). Thus, children evaluate people based on their food preferences, and may conflate outgroup membership with unfamiliar, or even disgusting, food selection.

Disgust and Development

Claims for adaptive origins must fit the facts of development. To date, only a few comprehensive studies of the development of disgust have been conducted (e.g., Stevenson, Oaten, Case, Repacholi, and Wagland 2010). However, existing evidence (some of which was reviewed previously) indicates that the experience of disgust and contamination avoidance develops slowly, does not reliably emerge until middle childhood, and remains robust throughout adulthood. Some aspects of disgust, such as being able to reliably identify the relevant facial expression in others, do not develop until around age 9 (Widen and Russell, 2013). Why might disgust show such a protracted development? This is a major puzzle from the perspective of the Physical Origins hypothesis. Some proponents of this hypothesis have addressed this issue by noting that disgust (like all adaptations) involves tradeoffs, including that it is adaptive to gradually learn what is unhygienic in a specific environment rather than deploying an innately fixed response that isn't calibrated to local conditions (e.g., Tybur et al. 2013). However, it is unclear why it should take so many years for this learning to take place. The costs of illness in early childhood are far from trivial, so this explanation may not present a sufficient tradeoff for gradually learning to experience disgust.

We argue that the Social Origins hypothesis clearly predicts a slower developmental trajectory, and is therefore more consistent with the existing developmental evidence (see the schematic presented in Figure 1). In particular, the Social Origins hypothesis predicts that reasoning about social groups and patterns of affiliation (which are already evident early in infancy and early childhood) are critical foundations for the development of disgust, particularly in the context of behavioral regulation and reputation management. While social cognition is initially facilitated by mechanisms other than disgust, it may be particularly advantageous for disgust and its concomitant functions to arise around middle childhood, when children begin to actively avoid outgroup members and when their social lives become more heavily dominated by concerns of reputation and status. This hypothesis additionally predicts that the content of disgust elicitors should be acquired through continued social experience with ingroup members.

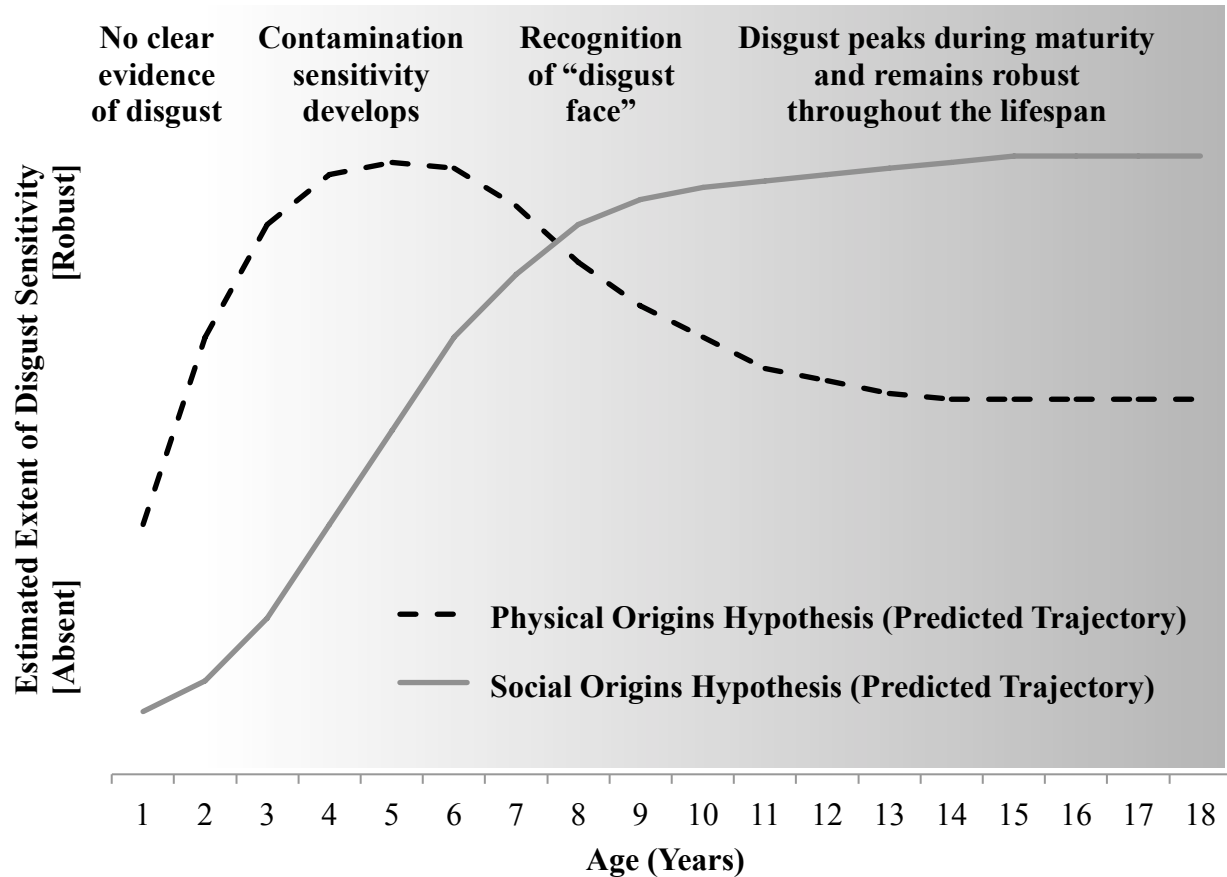


Fig. 1. Estimated disgust sensitivity across age, as predicted by the Physical Origins and Social Origins hypotheses. The Physical Origins hypothesis suggests that disgust sensitivity should peak at the age when children are most susceptible to disease, from the time of weaning and becoming fully mobile until the maturation of the immune system (approximately ages 3–5). The Social Origins hypothesis suggests that disgust sensitivity should increase during middle childhood and peak in adolescence, alongside children’s increasing contact with non-kin and gradual development of explicit outgroup prejudices. The captions at the top of the Figure indicate several important milestones in the ontogenetic emergence of disgust, as understood from existing data (reviewed in the main text and in Rottman 2014), which most closely maps onto the developmental trajectory predicted by the Social Origins hypothesis.

Young children are quite adept at reasoning about social groups from a very early age (see Banaji and Gelman 2013). Children are highly attentive to markers of social group membership (e.g., gender, race, age, language), and prefer to befriend and learn from individuals who look and sound like them (e.g., Baron and Banaji 2006; Gaither et al. 2014; Kinzler,

Corriveau, and Harris 2011; Kinzler and DeJesus 2013a, 2013b; Kinzler et al. 2009). Ingroup preferences emerge quickly, even when groups are marked only by arbitrary colors or novel labels, as has been robustly demonstrated through decades of research (e.g., Bigler, Jones, and Lobliner 1997; Misch, Over, and Carpenter 2016; Sherif et al. 1961). Children expect that individuals will prioritize members of their own group when sharing resources and may engage in harmful behaviors when in competition with another group (DeJesus, Rhodes, and Kinzler 2014; Rhodes 2012). In addition, research suggests that ingroup favoritism and outgroup denigration are two distinct attitudes, and that the former precedes the latter. Explicit forms of ingroup preference emerge by the age of 5, when outgroup prejudice is still weak or non-existent, and explicit outgroup prejudices do not begin to develop until after 6–7 years of age (Aboud 2003; Buttellmann and Böhm 2014; Nesdale 2007). While ingroup preference is likely driven by positive emotions such as compassion and the desire for social affiliation, the development of disgust in middle childhood may facilitate outgroup derogation. In other words, the timing of disgust and outgroup avoidance align, an observation that we suspect is not a random coincidence.

Given that children are highly attentive to social group markers, they may be especially prepared to learn about culturally-specific norms and disgust elicitors, which vary considerably across cultures (Herz 2012; Speth 2017) and are largely socialized (Oaten et al. 2014). Because the status of particular social categories – including the identity of outgroup members and misfits and the associated norms that go with them – are largely culturally dependent, the Social Origins hypothesis correctly predicts that disgust reactions should therefore be calibrated to ingroup norms and ideals rather than encompassing a prepared set of triggering stimuli. The striking cultural diversity of disgust elicitors, and the degree to which disgust is learned, is better predicted by the Social Origins hypothesis than the Physical Origins hypothesis.

Nuancing the Social Origins Hypothesis

We admit that the Social Origins hypothesis cannot fully account for several characteristic features of disgust. For example, this account provides no obvious explanation for why feces, corpses, and rot may universally elicit disgust (but see Speth, 2017, for ethnographic evidence contesting the universality of these elicitors), or why various sexual behaviors (many of which have been historically dangerous in terms of disease risk and mortality among

childbearing women) are commonly tabooed across cultures. Due to such limitations, we acknowledge that there is definite merit in the Physical Origins account as providing part of the explanation for the genesis of disgust.

These limitations of the Social Origins account do not fully undermine its plausibility, however. Due to evolutionary conservation and neural reuse (Anderson 2010), adaptations do not arise *de novo* or by saltation, but rather by gradual changes in selective pressures that capitalize on pre-existing adaptive features. It is therefore entirely reasonable that existing neural, physiological, and cognitive elements of distaste were exapted during hominid evolution in order to promote similar withdrawal tendencies in the face of undesirable social elicitors. This kind of low-cost avoidance behavior that was well-suited for rejecting bitter foods and vegetation would have also been an appropriate behavioral tendency in the face of repulsive or objectionable people, and plausibly a much more adaptive response than those typically elicited by anger or fear (i.e., fight or flight, which both require significantly more energy and/or entail significantly more risk than disgust-initiated avoidance). The superficial similarities of the distaste response and the disgust response should not lead to the conclusion that disgust is primarily “for” avoiding food and other disease-ridden materials. Rather, the proximate mechanisms involved in distaste, which prepare the body for withdrawal from a noxious stimulus, could have been capitalized upon merely because they adequately served the function of withdrawing from and thus ostracizing poor cooperative partners. Other aspects of distaste, including the gape face, may have been evolutionarily exploited to serve a signaling function (Kelly 2011). This signal may have been largely social in nature (e.g., disapproving of conspecifics’ behavior) rather than indicating the presence of disease-ridden substances, and may have been a critical element of the initial evolution of both disgust and morality. The exaptation of mechanisms related to distaste might explain why substances that would be undesirable to eat also trigger disgust.

Notably, this evolutionary hypothesis breaks strongly from the historical sequence proposed by others (e.g., Rozin, Haidt, and McCauley 2008; Tybur et al. 2013), as it doesn’t posit that *physical* disgust emerged from distaste and only recently gave way to *social* disgust. Rather, we tentatively propose that social functions of disgust were crucial from the beginning, such that there was no intermediary step in which a full-blown emotion of disgust served exclusively to regulate the avoidance of physical, non-social sources of poison and infection.

Conclusion

There is ample evidence that disgust promotes the avoidance of physical contaminants. However, disgust serves other functions as well (Strohminger 2014), and the disease-avoidance explanation alone may be an inadequate elucidation of the evolutionary origins of this complex emotion. In particular, we have argued that disgust affords social fitness in addition to physical fitness. In some cases, these functions may largely overlap. For example, disgust reactions toward particular foods might prevent the ingestion of disease vectors and simultaneously function as honest signals of group membership. This would explain why food taboos often involve meat and other substances that historically have been hotbeds of pathogen activity (Fessler and Navarrete 2003), but also why these taboos are culturally variable (Harris 1985) and why food is often utilized as an indicator of sociocultural boundaries (Lieberman et al. 2016; Shutts, Kinzler, and DeJesus 2013). In addition, although young children struggle to understand contamination (Blacker and LoBue 2016; DeJesus, Shutts, and Kinzler 2015), their sophistication in thinking about the social world, leading to greater tendencies to associate with norm-following ingroup members, may have the byproduct of avoiding disease. This degree of overlap suggests that it may be impractical to clearly differentiate discrete “subtypes” of disgust (e.g., pathogen disgust, sexual disgust, moral disgust) or to suggest that one form of disgust emerged from another.

Our novel hypothesis raises further research questions. For example, does disgust sensitivity correlate with concerns about social status? Are reputation-obsessed adolescents more easily disgusted than adults? To what extent are people more disgusted by social deviants who carry no particular disease threats than by socially normative individuals who are nevertheless contagious? To what extent do members of other cultures reliably experience disgust in the social domain? Future research on questions like these will be crucial in determining the plausibility of the Social Origins hypothesis.

Does this new view of disgust carry dangerous normative implications? That is, if it is “natural” for humans to experience disgust toward outgroup members and people who deviate from societal norms, does it become more warranted to stigmatize individuals who fail to adhere to ingroup norms? Certainly not; evidence of what is natural provides no moral compass as to how one should act. If anything, evidence that disgust is a particularly insidious moral emotion – insofar as it can lead to bigotry, dehumanization, and tribalism – should lead us to fight against

our natural tendencies to experience disgust within particular social situations (Kelly 2011; Nussbaum 2004; but see Kumar 2017). Indeed, if disgust is generally problematic in regulating social interactions, and if (as we argue) disgust is primarily a social emotion, this may provide an even stronger debunking argument than has been made previously. We may be better off by doing everything in our power to overcome the consequences of our capacity to experience disgust. This will not come easily, particularly as efforts to impede other problematic elements of human psychology have had limited long-term success (e.g., Lai et al. 2016). If we are to have any hope of developing effective interventions for overriding disgust, thereby precluding certain forms of pervasive discrimination, it is imperative that practitioners set about this quest with an accurate theory of the evolution of disgust.

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