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When and How Disgust is and is Not Implicated in the Behavioral Immune System

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The intuitive psychology of disease-avoidance manifests in two broad categories of human behavior: *reactive* avoidant responses to infection-connoting perceptual stimuli, and *proactive* strategies that manage the latent threat of infection even when no such stimuli are in evidence. Reactive avoidance typically coincides with the arousal of disgust, whereas many proactive behaviors are unaccompanied by disgust. Although this might appear to imply that disgust is typically an antecedent cause of reactive but not proactive behaviors, the opposite may be true. Disgust may often accompany reactive avoidance but not cause it. In contrast, because of its effects on memory, attitudes, and interpersonal communication, disgust may have long-term causal consequences for proactive behavioral strategies. This analysis may have implications for understanding the evolution of disgust, and for its function within the context of the behavioral immune system.

Keywords: disgust, disease, conformity, behavioral immune system

Animals of many kinds employ behavioral strategies that limit their exposure to disease-causing pathogens. Some of these behaviors are reactive responses to specific stimuli appraised as pathogenic, such as when lobsters and frogs avoid contact with already-infected lobsters and frogs (Behringer, Butler, & Shields, 2006; Kiesecker, Skelly, Beard, & Preisser, 1999). Other behaviors are more proactive, such as the tendency for ants to line their nests with antibiotic resins (Chapuisat, Oppliger, Magliano, & Christe, 2007). Humans too exhibit an intuitive disease-avoidant psychology—a kind of "behavioral immune system"—that is triggered especially strongly under conditions in which they perceive themselves to be more vulnerable to infection. In humans, activation of this behavioral immune system produces not only predictable behavioral outcomes, but also additional cognitive and affective outcomes (Schaller & Park, 2011). It is for this reason that, when applied to human psychology, the concept of a behavioral immune system represents more than merely a glib appropriation of the "immune system" terminology. It really does appear to be a *system*—perhaps a unique motivational system (Aunger & Curtis, 2013; Bernard, 2012)—comprised of functionally distinct psychological mechanisms that operate in a complex and coordinated fashion.

Functionally specific motivational systems are closely associated with specific affective states (e.g., hunger, thirst, fear, sexual arousal). The behavioral immune system is closely associated with disgust. Although disgust—as experienced and expressed by humans—may have ancient evolutionary roots in a rudimentary distaste response to tainted foodstuffs (Rozin, Haidt, & McCauley, 2008), it is widely considered to have evolved as a means of serving a broader disease-avoidance function, and lots of evidence attests to this conclusion (Curtis, DeBarra, & Aunger, 2011; Oaten, Stevenson, & Case, 2009; Tybur, Lieberman, Kurzban, &

DiScioli, 2013). For instance, disgust is typically elicited by stimuli that connote infection risk (Bradley, Codispotti, Sabatinelli, & Lang, 2001) and this disgust response is especially intense when perceivers' own vulnerability to infection is especially great (Fessler, Eng, & Navarrete, 2005). The connection between disgust and the disease-avoidance motivational system is so tacitly tight that some researchers use the former to refer to the latter ("the disgust motive"; Aunger & Curtus, 2013), and this is an entirely reasonable thing to do.

Because disgust is so obviously integral to the human behavioral immune system, it may be tempting to assume that the arousal of disgust accompanies any form of behavioral prophylaxis that the system produces. It may also be tempting to assume that, whenever the arousal of disgust accompanies a disease-avoidant behavioral response, disgust is an important causal antecedent of that behavioral response. Both of these assumptions are probably wrong. At the very least, the manner in which disgust is implicated in the behavioral immune system is probably more varied, and more subtle, than commonly assumed.

In this essay, I attend to the distinction between *reactive* and *proactive* forms of behavioral defense (a distinction that I elaborate on in greater detail below) and suggest that, although disgust typically accompanies reactive avoidance of infection-connoting perceptual stimuli, many proactive acts of behavioral defense are unaccompanied by the arousal of disgust. I then consider the causal implications of disgust for both reactive and proactive behavioral strategies. I suggest that even though disgust typically accompanies reactive avoidance of infection-connoting stimuli, disgust may often be a mere concomitant but not an antecedent cause of those avoidant actions. In contrast, even though disgust often may not be aroused when people actually engage in proactive forms of behavioral defense against infection, disgust may nonetheless play an especially important causal role in facilitating effective proactive strategies. My hope is that these speculations may contribute toward a more carefully articulated understanding of exactly when and how disgust is (and isn't) implicated in behavioral defense against infection.

Disgust as a Typical Concomitant of Reactive (But Not Proactive) Responses

Many examples of behavioral prophylaxis are defined by behavioral avoidance of specific entities within an individual's immediate perceptual vicinity—entities that, on the basis of sensory cues, intuitively connote an immediate risk of infection. These are *reactive* responses. In humans, reactive responses of this sort are typically accompanied by disgust. The sight or smell of feces reliably elicits disgust, and people avoid touching whatever it is that has that look or smell (Rozin, Millman, & Nemeroff, 1986). Similarly, although less intensely, people are disgusted by bodily disfigurement, and avoid contact with disfigured people (Park, Faulkner, & Schaller, 2003; Ryan, Oaten, Stevenson, & Case, 2012). Indeed, the intensity of disgust elicited by an object is very highly correlated with individuals' unwillingness to touch that object (Ryan et al., 2012).

In addition to those reactive responses, the human behavioral immune system also has implications for cognitions and behaviors that serve as more *proactive* forms of defense against potential infection. Even in the absence of any immediate perceptual evidence of infectious entities, people have the capacity to be aware of the latent threat posed by infectious diseases; and, as a consequence, they engage in behavioral strategies that proactively manage that threat—reducing the likelihood that the latent threat actually manifests in ways that would even require reactive avoidance. A good example is provided by research linking the behavioral immune system to conformist attitudes and behaviors (e.g., Murray & Schaller, 2012). Historically,

adherence to local cultural norms—perhaps especially norms pertaining to food preparation, hygiene, and intimate interpersonal relations—served as an important means of inhibiting the spread of infectious diseases. (On the basis of research evidence in medical anthropology, it has been suggested that, in pre-industrial societies, “most conventions pertaining to subsistence and social behavior operate as prescriptions to avoid illness; almost all rules have health implications” [Fabrega, 1997, p. 36].) Consequently, normative behavior—by oneself and by others within the one’s local community—would have offered adaptive benefits, especially when the latent threat posed by pathogens was relatively high. Implications persist in contemporary social contexts: When people are, or merely perceive themselves to be, more vulnerable to pathogen infection, they more strongly encourage behavioral conformity in others and are more likely themselves to conform to majority opinion (Murray & Schaller, 2012; Murray, Trudeau, & Schaller, 2011; Wu & Chang, 2012).

Are these conformist responses immediately preceded—or even accompanied—by the arousal of disgust? If they are, it is far from obvious. Certainly disgust can be elicited by perceived *violations* of cultural norms (Haidt, McCauley, & Rozin, 1994; Tybur et al., 2013). So perhaps one could make the argument that, when people are aware of the latent threat posed by pathogens, and are presented with the opportunity to conform to majority opinion, they first consider nonconformity as an option, experience disgust at the thought of nonconformity, and consequently choose conformity instead. That argument isn’t entirely implausible; but it is causally convoluted and there is no empirical evidence that substantiates it. So, while the arousal of disgust may often coincide with reactive behavioral avoidance of overtly pathogenic stimuli, I suspect that many proactive forms of behavioral defense—such as behavioral conformity with social norms—are engaged without any accompanying arousal of disgust.

Disgust as an Important Causal Antecedent to Proactive (But Not Reactive) Responses

Disgust may be acutely aroused in the context of reactive avoidance of infection-connoting perceptual objects; but that does not mean that the arousal of disgust is a causal antecedent to that reactive response. Disgust may not be aroused in the immediate context of conformity behavior; but disgust may still have played an important causal role in producing that proactive defense against infection. I will elaborate on each of these statements in turn.

Consider first the case of reactive avoidance (in which disgust actually *is* aroused): In many such instances, the arousal of disgust may simply be coincident with, rather than an actual cause of, behavioral avoidance. This is not a novel or provocative point; the primacy of motor responses over emotional experiences dates back to William James (1890), and to Charles Darwin (1872) before him. Nor is this suggestion mere speculation; it is informed by empirical evidence. Take a closer look at the results reported by Ryan et al. (2012). Their study included a manipulation that varied the extent to which perceptual stimuli connoted an immediate infection risk, and also included measures of disgust elicited and behavioral avoidance of contact. Results revealed very strong effects of the manipulation on both disgust and behavioral avoidance. Interestingly, though, the effect of the manipulation on behavioral avoidance was stronger than the effect on disgust—exactly the opposite of what one would expect if disgust was a causal antecedent to behavioral avoidance. I don’t want to draw overly strong conclusions from this one particular pattern of results. I mention it only to illustrate the real possibility that, even in those circumstances in which both disgust and behavioral avoidance very obviously co-occur, disgust may often be an affective concomitant rather than an antecedent cause of those avoidant behaviors. The implication is that the capacity that people (and other animals) have to reactively

avoid infectious things in their immediate environment is not causally dependent on their capacity to experience disgust.

If this is true the question must be asked: Just what unique benefits does disgust—as experienced and expressed by humans—offer in the service of disease-avoidance? Emotions are not free. Metabolic resources are consumed during the development of physiological mechanisms that allow people to experience emotions. Additional resources are consumed every time those emotions are aroused. It is unlikely that the human emotion of disgust would have evolved as it has—such that it is so strongly aroused by disease-connoting stimuli—unless it was associated with unique disease-avoidant benefits that outweighed its costs. What might those benefits be?

I suspect that the most important disease-avoidant benefits of disgust have less to do with any effects on reactive avoidance of immediate infection risks, and more to do with its long-term consequences for effective *proactive* management of enduring infection risks. This suggestion may seem surprising given the observation that proactive behaviors are often unaccompanied by the concurrent arousal of disgust. But the argument here does not depend upon concurrency of disgust and proactive actions; the argument focuses instead on causal implications that play out over long stretches of time. There are several important psychological reasons why the arousal of disgust at one moment in time may have causal consequences for effective proactive responses in the future.

First of all, disgust is a potent memory aid (Chapman, Johannes, Poppenk, Moscovitch, & Anderson, 2013). The arousal of disgust may facilitate the formation of mental representations of pathogenic entities (e.g., people displaying obvious symptoms of infection), and these mental representations are likely to persist even when those entities are no longer in evidence. These enduring memories may consequently facilitate proactive behavioral strategies that reduce the likelihood of coming into close proximity with those entities—or other entities with similar features—in the future. The same principle applies not just to entities but also events (e.g., violations of cultural norms). If some perceived event is associated with the arousal of disgust, that event is likely to be remembered, and this lingering memory can facilitate the deployment of behavioral strategies that reduce the likelihood that similar events will transpire in the future.

Disgust may also have implications for the acquisition of attitudes and preferences of various kinds, which also can have enduring implications for proactive behavioral strategies. For instance: If disgust is aroused when someone encounters a person who looks, sounds, or smells subjectively “weird,” this may facilitate the learning of xenophobic attitudes toward foreign peoples, and may also indirectly facilitate the learning of favorable attitudes toward familiar peoples. Those xenophobic and ethnocentric attitudes endure over time, and provide a basis for behavioral strategies that reduce the likelihood of future encounters with cultural outsiders (who, in ancestral ecologies, may have been especially likely to violate local cultural norms and thus pose a threat of disease transmission; Faulkner, Schaller, Park, & Duncan, 2004). Similarly, if disgust is aroused by the observation of any overtly problematic norm violation (e.g., defecation in a communal kitchen), this may facilitate the acquisition of antipathy toward nonconformity as well as an attitudinal preference favoring conformity—attitudes that are especially likely to be activated into working memory, and to be behaviorally expressed, when the latent threat of infection seems especially high. Although disgust may not actually be aroused at the time these proactive behavioral responses are enacted, this ostensibly disgust-free behavioral response may have been indirectly facilitated by previous instances in which disgust was aroused.

The arousal of disgust may not only have enduring implications for individuals' own proactive behaviors, but also for others' proactive behaviors too. One reason is rooted in observational learning. In humans, the acute arousal of disgust is accompanied by a characteristic facial expression. This facial expression communicates useful information to observers, and those observers learn from it. Thus, just as people (and other primates) learn to avoid predators by observing others' fearful facial expressions (Mineka & Cook, 1993; Olsson & Phelps, 2007), people (including young children) also learn to avoid potentially infectious things by observing others' expressions of disgust (Repacholi, 1998; Stevenson, Oaten, Case, Repacholi, & Wagland, 2010). Disgust also facilitates other forms of social learning—including the uniquely human learning processes that involve the use of language. Empirical evidence reveals that disgust-eliciting stories are especially likely to be told and retold (Heath, Bell, & Sternberg, 2001). More generally, the arousal of disgust may be a potent motivator of interpersonal communication, compelling people to tell others about the potential dangers associated with the entities and events that previously elicited disgust. The overall implication is that, because of its communicative consequences, the arousal of disgust in one individual at one moment in time enhances other individuals' ability to proactively avoid infection in the future. To the extent that others' proactive strategies are successful, the risk of infection is reduced within the entire community—providing group-level benefits that accrue to those individuals who experienced, and expressed, disgust in the first place.

In sum, the arousal of disgust almost certainly does have beneficial causal consequences for behavioral avoidance of infection. However, the most beneficial causal consequences may not manifest in any immediate or obvious way. Given its potent effects on memory, on attitude formation, and on social communication, the experience (and expression) of disgust at any one moment in time may have beneficial consequences for the effective deployment of proactive behavioral strategies—by individuals, and by whole communities of people—much later in time.

Implications and Future Research

The observations and ideas that I've presented in this brief essay are largely speculative and cannot be convincing unless they are exposed more rigorously to empirical inquiry. For instance, I have suggested that disgust indirectly facilitates proactive behavioral defense as a consequence of its effects on memory and on attitude formation. In order to determine if there is any merit to this suggestion, it will be necessary to conduct experiments that rigorously examine the effects of disgust on memory and on attitude formation, and also examine the further consequences of those memories and those attitudes on conformity and other forms of proactive behavioral defense. I also suggested that the expression of disgust communicates useful information to other people, which in turn leads those other people to more successfully engage in proactive behaviors that benefit the entire local community. In order to determine whether there is any merit to this suggestion, it will be necessary to devote careful empirical attention to individuals' public expressions of disgust—in facial expressions and in verbal communication—and to the further implications that these public expressions have for others individuals' proactive behavioral strategies.

Some of these speculations imply specific hypotheses that may merit empirical attention. For instance, speculation about the communicative function of disgust (and its further implications for others' proactive behavior) implies that disgust responses to disease-connoting stimuli may be modulated by the specific social context within those stimuli are perceived, and that this effect is likely to be observed especially on public expressions of disgust. More

exaggerated facial expressions of disgust may be observed not just in the presence (rather than absence) of other people, but especially in the presence of people who are friends, family, and/or members of one's local community.

In addition to their implications for empirical research, the concepts and ideas identified in this essay may also have some utility in guiding further theoretical development regarding disgust, and on the behavioral immune system more generally. At the very least, the distinction between reactive and proactive forms of behavioral defense may prove to be conceptually useful. This distinction may provide a conceptual context within which to better predict, and explain, the circumstances under which disgust either does or does not mediate the effect that the perceived threat of disease has on cognition and behaviors (e.g., McCarthy & Skowronski, in press). The distinction might also be fruitfully applied to domains of behavior that are not discussed in this essay. I focused here on just one kind of proactive behavioral strategy (conformity with and maintenance of social norms). Other kinds of behaviors can also be characterized as proactive—such as the strategic selection of mates with phenotypic features connoting disease-resistance and "good genes" more generally (Tybur & Gangestad, 2011). The role of disgust in the context of mating behavior is a topic of some interest (Tybur et al., 2013), and research on this topic may benefit from further consideration of the extent to which behaviors in the mating domain fit the characterization of reactive versus proactive responses. More broadly, the distinction between reactive and proactive behavioral defense may be useful to keep in mind when developing conceptual arguments regarding exactly how, when, and why disgust evolved in ancestral human populations.

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