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Spit, Disgust, and Parasite Stress Theory: A Message Experiment

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Public health interventions targeting coughing and spitting during the Tuberculosis and 1918 flu epidemics were largely successful. Specifically, public health officials' messaging framed the behavior of spitting as repulsive and endangering to others, prompting an elicitation of disgust. Anti-spitting campaigns – messaging that focuses on the threat of spit or sputum – have long been common during pandemics and manifested once again to combat the spread of COVID-19. Yet, few scholars have theorized if and how anti-spitting campaigns function to change behavior. One possibility is parasite stress theory, which posits that human behavior is driven by a desire to avoid pathogenic threats like spit. The application of these types of disgust appeals in public health messaging remains understudied and warrants exploration. To test the applicability of the parasite stress theory, our message experiment with US adults ($N = 488$) examined reactions to anti-spit messages that varied in visual disgust (low and high). For more highly educated respondents, the high disgust appeal directly decreased spitting intentions, and this relationship was stronger for individuals with higher levels of pathogen and moral disgust. Given the importance of public messaging during pandemics, future research should continue to examine the efficacy and theoretical underpinnings of specific disgust appeals.

Historically, public health entities worked to control the spread of infectious disease by communicating the risks of behaviors that could spread droplets, such as coughing without covering one's mouth or spitting in public (Abrams, 2013). Anti-spitting campaigns led by public health agencies have a long history in the United States and around the world (Aimone, 2010). Seeking to reduce the spread of germs and pathogens attributable to the Tuberculosis (TB) and 1918 Flu pandemics, these campaigns villainized spitting not only as a filthy habit but also as a behavior potentially harmful to others as a spreader of disease (Abrams, 2013; Aimone, 2010). Anti-spitting campaigns leveraged disgust appeals, positioning spitting as a repulsive behavior harmful to others (Leshner, Bolls, & Wise, 2011; Oum, Lieberman, & Aylward, 2011).

Researchers across multiple fields have long called for increased scholarship examining disgust and disgust appeals (Diaz & Cova, 2021; Haidt, McCauley, & Rozin, 1994; Leshner, Bolls, & Wise, 2011), and a growing program of research has sought to understand disgust using the parasite stress theory. Positing that humans have evolved to activate their adaptive psychological response mechanisms to avoid pathogenic threats, parasite stress theory argues that disgust

cues and appeals influence behavior because they are interpreted as indicators of infectious danger (Brown, Fincher, & Walasek, 2016; Fincher & Thornhill, 2012; Schaller & Duncan, 2007; Thornhill & Fincher, 2014). A recent study found that individuals' higher disgust proneness is associated with greater likelihood of influenza vaccine uptake, lower influenza vaccine hesitancy, and future influenza vaccine uptake (Shook, Fitzgerald, Oosterhoff, MacFarland, & Sevi, 2022). As these disgust cues are often visual (Haidt, McCauley, & Rozin, 1994), from the perspective of parasite stress theory, anti-spitting campaigns function as a disgust cue that can trigger adaptive psychological response mechanisms (Oum, Lieberman, & Aylward, 2011).

The goal of our study is to examine individuals' responses to anti-spit messages that do or do not include visual disgust appeals. In line with parasite stress theory, both state-based disgust and dispositional disgust, specifically moral and pathogenic, are examined as mediators/moderators (Thornhill & Fincher, 2014). In response to previous calls for further exploration of the role of dispositional disgust on distortional message appeals drawn from the parasite stress theory (Gorissen et al., 2022), our study aims to better delineate relationships of visual disgust appeals on spit intention. To explicate the theoretical and practical goals of the research, the manuscript begins with an overview of historical anti-spitting campaigns, parasite stress theory, and disgust and current uses of disgust appeals in public health messaging.

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History of Anti-Spitting Campaigns

Anti-spitting campaigns have a significant history in the United States (US) beginning with the TB outbreak (Abrams, 2013) and 1918 Flu pandemic (Aimone, 2010) at the beginning of the 20th century. The rampant spread of TB prompted health officials to develop interventions to reduce the mortality and spread of TB. As an asymptomatic infection, TB is spread via aerosolization – namely coughing, sneezing, and spitting (Teller, 1988) – of *Mycobacterium tuberculosis* bacteria (Centers for Disease Control and Prevention, 2005), consistent with findings from Robert Koch’s germ theory (pathogens being spread via germs) (Abrams, 2013). This led to anti-spitting campaigns primarily designed to prevent the spread of the *sputum vector* of the bacterial contagion. TB mortality dropped by 60% from 1900 to 1930 due to the successes of public health interventions, including anti-spitting campaigns from public health departments (Jones, Podolsky, & Greene, 2012). These successes also guided messaging for curbing the spread of the 1918 Flu pandemic (Aimone, 2010). This historical success of anti-spitting campaigns in the context of the TB outbreak would continue to set a precedent for interventions in infectious disease epidemics.

Parasite Stress Theory & Dispositional Disgust

One framework that helps explain individual reactions to anti-spitting campaigns is the parasite stress theory. Largely an evolutionary theory, the parasite stress theory posits that humans engage in infection-avoidant behaviors via the operation of a behavioral immune system, which is comprised of adaptive psychological response mechanisms (Brown, Fincher, & Walasek, 2016; Schaller, 2011). Humans were able to survive the evolutionary process because they recognized the importance of avoiding death or disability due to infections from various sources. Notably, parasite stress theory positions disgust cues as key to understanding human response, as humans attach disgust to stimuli or behaviors that represent pathogenic risk (Fincher & Thornhill, 2012; Schaller & Duncan, 2007; Thornhill & Fincher, 2014). Certain stimuli serve as disgust cues (e.g., spit), prompting an avoidance response via disgust and cognitive processing of pathogen potential. Historically, once public health officials recognized that TB was spread via sputum, they recognized the importance of attempting to curb the behavior and developing messages that reinforced it as filthy and dirty. Parasite stress theory, thus, posits that anti-spitting messages may have been effective because they represented a disgust cue that triggered the behavioral immune system to respond. Disgust, defined by Charles Darwin (1965/1872) as “something revolting, primarily in relation to the sense of taste, as actually perceived or vividly imagined” (p. 250), has a long history of recognition as a basic human emotion that can yield a culturally universal facial expression (Ekman & Friesen, 2003), idiosyncratic physiological responses (Rozin & Fallon, 1987), and activation of the autonomic nervous system (Ekman, Levenson, & Friesen, 1983). Yet, disgust has been hard to conceptualize with robust sensitivity, in that past research (1) focused on specific domains of disgust

(e.g., moral or pathogen disgust), (2) did not address multicollinearity with other similar constructs, and (3) struggled to explicate distinctions between different disgust elicitors (Tybur, Lieberman, & Griskevicius, 2009).

To address these issues, Tybur, Lieberman, and Griskevicius (2009) developed a measurement tool based on Haidt, McCauley, and Rozin (1994) scholarship that divides disgust elicitors into three distinct categories: sexual, moral, and pathogen disgust. Sexual disgust reflects reactions to unwanted sexual contact, serving as the antithesis of sexual arousal; serving as the prototypical response to thinking of incestuous sexual relations (Ackerman, Kenrick, & Schaller, 2007; Fessler & Navarrete, 2004; Koukounas & McCabe, 1997; Tompkins, 1963; Tybur, Lieberman, & Griskevicius, 2009). Moral disgust pertains to social transgressions, reported as antisocial, nonnormative behaviors, such as lying, cheating, stealing, or causing direct harm to others (Haidt, McCauley, & Rozin, 1994; Nabi, 2002; Tybur, Lieberman, & Griskevicius, 2009). Sexual disgust may not be directly related to spitting, but moral disgust could influence/moderate reaction to the behavior. Spitting and coughing around others during a pandemic (TB, 1918 Flu villainization of spitting and coughing in public) and non-pandemic times (criminalization of HIV positive persons spitting on others) may be perceived as a contentious moral issue (see Abrams, 2013; Aimone, 2010; Satta, 2019). At the time, spitting was viewed as a behavior that could spread the diseases of the era, as well as a filthy habit of the working class, leading to officials using both moral and pathogenic type messages to curb the behavior (Abrams, 2013; Aimone, 2010). As such, perhaps among different levels of socioeconomic status, moral disgust could moderate disgust appeal and dispositional disgust outcomes.

The third category of dispositional disgust – pathogen disgust – is the most relevant to anti-spit messaging. Pathogen disgust is incited by objects perceived as likely to contain infectious agents, such as dead bodies and rotting food, and bodily fluids like feces, vomit, blood, and spit (Tybur, Lieberman, & Griskevicius, 2009). Consistent with parasite stress theory, prior scholarship has posited that pathogenic disgust evolved specifically to serve the function of pathogen avoidance (Curtis & Biran, 2001; Curtis, Aunger, & Rabie, 2004; Fessler & Navarrete, 2003; Marzillier & Davey, 2004; Tybur, Lieberman, & Griskevicius, 2009). Key to pathogenic disgust elicitation are stimuli ranging from visual, olfactory, tactile, or auditory cues that indicate pathogen presence (Rozin, Millman, & Nemeroff, 1986). In other words, pathogenic disgust is an evolutionary trait humans developed over time, eliciting response mechanisms via the behavioral immune system, and leading people to find these stimuli disgusting and avoid them. Historically, spitting was viewed as a filthy and disgusting habit, and in the context of TB and the 1918 Flu led to the passing of anti-spitting ordinances. These successful campaigns have led some current public health officials to develop moral disgust appeals in public health campaigns to curb harmful behaviors related to chronic conditions, a notable shift from a focus on infectious diseases. However, disgust appeals may not always elicit their intended effects.

Disgust Appeals in Public Health Messaging

More recent disgust appeals have addressed health behaviors like smoking tobacco, drinking alcohol, and obesity-related factors (Kemp, 2018) and worked to shift attitudes and influence behavior change. However, similar to fear appeals (Tannenbaum et al., 2015), through seeking to evoke an emotional response, messages can backfire on their desired effects. Lupton (2015), using disgust appeals as the central focus of public health messaging, proposes a “pedagogy of disgust” to encompass the use of disgust as a motivational tool in public health campaigns using voices perceived as authoritative by target audiences. The logic behind these appeals through using powerful messages is to evoke intense emotional responses from apathetic or resistant audiences to public health messages (Crawshaw, 2012; Gagnon, Jacob, & Holmes, 2010; Lupton, 2015; Mulderrig, 2018). Yet, much of the published research on these disgust appeals does not expand upon the different dimensions of disgust. Within chronic diseases, dispositional disgust appeals may be used in tandem with moral disgust (social implications), however pathogenic disgust is often not as applicable within these contexts. As such, there is a notable dearth of research related to dispositional disgust, especially pathogenic disgust related to behaviors that could spread infectious diseases.

Additionally, often ignored in public health campaigns are the pleasures that may be involved with the transgressive behaviors. During the TB and 1918 flu outbreaks, spitting was initially hard to curb due to transgressors reporting the pleasure they got from the behavior (Abrams, 2013; Aimone, 2010). Public health officials in countries like India and China are currently facing challenges in reducing spitting behaviors as to many it is considered a pleasurable behavior (Coomber, Moyle, & Pavlidis, 2018; Kar, Pandey, & Singh, 2020). Significantly, these disgust appeals that may lean more moral typically most affect more psychologically or socially vulnerable populations. For those who feel disempowered, distressed, or socioeconomically disadvantaged – by means of education level and income, for example – exposure to these types of campaigns may well make these populations feel worse and/or powerless (Hastings, Stead, & Webb, 2004; Van’t Riet & Ruiter, 2013). In direct opposition to the desired effects of empowered decision-making, anger, retreatment, guilt, and despondency have been registered as responses to disgust messaging and negative emotion elicitation (Brennan & Binney, 2010; Lupton, 2015). Further, reactance and defensiveness have been activated in the face of disgust appeals in overt public health messaging (Lupton, 2015; McPhail-Bell, Bond, Brough, & Fredericks, 2015; Ramos Salas, 2015; Thompson & Kumar, 2011).

Anti-Spitting and COVID-19

Anti-spitting campaigns have emerged again in response to the COVID-19 pandemic. The pandemic heightened global awareness for the threat of bodily droplets in spreading the infection (Xu, Li, Gan, Du, & Yao, 2020). In some countries, these campaigns are a continuation of the existing anti-spitting efforts – mirroring, in many ways, the language and features of TB messaging during the early 1900s. For

example, India utilized anti-spitting campaigns to curb the behavior during the COVID-19 pandemic (Kar, Pandey, & Singh, 2020). Other countries are utilizing alternative message strategies that focus on water droplets. With COVID-19 being most commonly spread via droplets (World Health Organization, 2020a), the salivary gland is particularly important, as it serves as one of the most important reservoirs of the COVID-19 pathogen (Xu, Li, Gan, Du, & Yao, 2020). Theoretically, if an infected person spits openly, the COVID-19 pathogen will be aerosolized for a limited time, with the surface of the sputum being infected for several hours. If others come into contact with that surface, they risk infection (Kar, Pandey, & Singh, 2020).

Historical examples of anti-spitting campaigns have influenced current policies and practices in attempts to curb the behavior. More recently, India and China have been trying to curb the behavior by ordinances and posting signs that say, “No Spitting” in their native languages, but have had limited impact (Coomber, Moyle, & Pavlidis, 2018). While in these settings, spitting is viewed as a pleasure-generating behavior, and it is of interest to further explore how disgust – particularly, pathogen disgust – could be leveraged to curb the behavior, as spitting could be perceived as a prime method of transmission. As such, we study individuals’ responses to visual stimuli of sputum, their affective responses, and behavioral intentions of engaging in COVID-19 precautionary behaviors, namely not spitting.

Hypotheses & Research Questions

Within the context of COVID-19 pandemic and the behavior of spitting and based on current and historical anti-spit messaging, the current study sought to understand public reaction to anti-spit messages. Although there is some evidence that disgust appeals can evoke reactance, this is within in a chronic disease context. As the current study context is within an infectious disease context, the parasite stress theory guided hypothesis formulation. From a theoretical standpoint, the current study engaged four hypotheses derived from parasite stress theory:

H1: Compared to a low disgust message, a high disgust message will trigger increased state-based disgust.

H2: Compared to a low disgust message, a high disgust message will trigger decreased intentions to spit.

H3: Increased dispositional pathogen disgust will moderate the impact of a disgust appeal such that a high disgust message will trigger increased disgust (H3a) and decreased intentions to spit (H3b).

H4: The high disgust appeal will have a conditional, indirect effect on intentions to spit via state-based disgust, contingent on dispositional pathogen disgust. Specifically, (a) the high disgust appeal will trigger greater state-based disgust than a low disgust appeal leading to reduced intentions to spit, and (b) the association between the disgust message and state-based disgust will be stronger for those higher in dispositional pathogen disgust (See Figure 1).

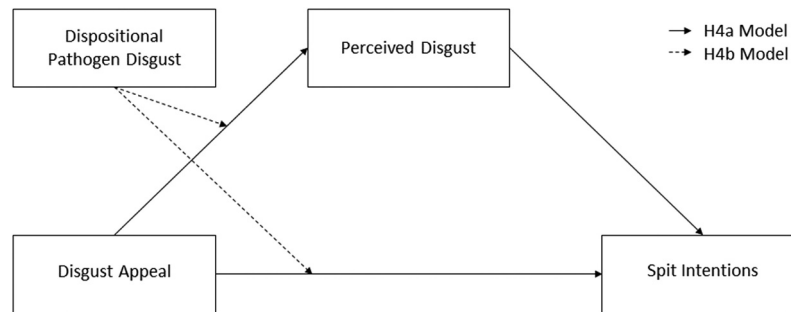


Figure 1. Hypothesis 4 pathways of indirect effects of dispositional pathogen disgust.

Two research questions guide the study. While pathogen disgust is the logical dispositional moderator for spit stimuli, there is also reason to believe that moral disgust could impact how people perceive the message.

RQ1: Does dispositional moral disgust moderate the impact of the disgust appeal.

Demographic factors could influence response too, notably sex and education. Past research has demonstrated that women and those with more education respond more strongly to disgusting stimuli (Al-Shawaf, Lewis, & Buss, 2018; Berger & Anaki, 2014). Women, notably, tend to be more disgusted than men, attributable to sexual and pathogen disgust appeals. Al-Shawaf and colleagues put forth multiple hypotheses of why and posed questions of disgust, attention, memory, communication, and specialized inference mechanisms that were hypothesized to differ as an evolutionary adaptation from men (Al-Shawaf, Lewis, & Buss, 2018; Buss, 1995). Similarly, regarding education, it is posited that those with higher levels of education will know more of the risks of pathogens and will be more susceptible to pathogen disgust appeals than those with lower levels of education, yet has only found modest effects (Berger & Anaki, 2014). This finding may be applicable to disgust appeals and reactance noted for socially vulnerable populations as well (Lupton, 2015). With these two demographic factors having strongest documented relationships with disgust appeal outcomes, our second research question is:

RQ2: Does participant sex or education moderate the impact of the disgust appeal?

Method

Design

From November 16 to 20, 2020, a sample of US adults ($N=488$) was recruited via Qualtrics Panels to participate in an online experiment examining the efficacy of anti-spit messaging featuring either a visual of spit on the ground (high disgust condition) or the same visual with a red “no” symbol replacing the spit (low disgust condition). A pretest survey captured measures of

dispositional pathogen disgust and moral disgust prior to message exposure, and a posttest captured state-based measures of disgust, intentions to spit on the ground, and demographic information. Digital consent was collected at the beginning of the pretest survey, and all stimuli and procedures were approved by the primary author’s institutional review board.

Participants

Among the 488 participants, 246 (50.4%) identified as male and 242 (49.6%) identified as female, with a mean age of 38.85 ($SD=16.02$). In addition, 362 (74.2%) participants identified as White, 93 (19.1%) as Black or African American, 17 (3.5%) as Asian or Pacific Islander, 14 (2.9%) as American Indian or Alaskan Native, and 28 (5.7%) reported being some other race. Seventy (14.4%) identified as Hispanic, Latinx, or Spanish in ethnicity. In terms of political affiliation, 250 (51.2%) participants identified as Republicans and 238 (48.8%) as Democrats. Finally, 243 (49.8%) participants reported a high school education or less, and 245 (50.2%) participants reported education beyond high school.

Stimuli

Participants were randomly assigned to view an anti-spitting message that was high or low in disgust (see Appendix A for the stimuli messages). The disgust manipulation was operationalized as a visual depicting spit on the ground. The low disgust condition depicted a red “no” symbol on the ground in place of the spit. Both visuals were accompanied by text that read “Spit has over 600 types of bacteria and germs. Please don’t spit in public.” Perceived disgust was measured to assess the veracity of the manipulation. In line with O’Keefe (2003), the current study does not report that as a manipulation check, but includes it as a mediator.

Measures

State-Based Disgust

Disgust was measured using Shen’s (2010) three-item measure, which asks participants “how much did this message make you feel ...” sickened, disgusted, and revolted. Participants responded via a scale ranging from 1 (*none of this emotion*) to 7 (*a great deal of this emotion*) with 4 designated as neutral ($M=4.46$, $SD=1.90$, $\alpha=.93$).

Table 1. Bivariate correlations

	1.	2.	3.	4.	5.	6.	7.	8.
1. Disgust Appeal	-----							
2. Education	-.02	-----						
3. Political Party	-.03	.02	-----					
4. Sex	-.04	.00	-.05	-----				
5. Age	-.02	-.04	-.14**	-.07	-----			
6. Pathogen disgust	-.09	-.07	-.01	-.11*	.21***	-----		
7. Moral disgust	-.01	-.12**	-.11*	-.10*	.33***	.51***	-----	
8. Disgust	.20***	.04	.07	-.07	.13**	.27***	.21***	-----
9. Spit intentions	-.05	-.01	-.12**	.33***	-.20***	-.24***	-.16***	-.32***

Dispositional Disgust

Two domains of dispositional disgust (pathogen and moral) were measured using a scale from Tybur, Lieberman, and Griskevicius (2009). For both scales, participants were given a prompt, “The following items describe a variety of concepts. Please rate how disgusting you find the concepts described in the items, where 0 means that you do not find the concept disgusting at all, and 6 means that you find the concept extremely disgusting.” They responded via a seven-point scale ranging from *not at all disgusting* (0) to *extremely disgusting* (6). For pathogen disgust, participants responded to seven items (e.g., stepping on dog poop, seeing a cockroach run across the floor, sitting next to someone who has red sores on their arm) ($M=5.56$, $SD=1.20$, $\alpha=.84$). For moral disgust, participants responded to seven items (e.g., stealing from a neighbor, deceiving a friend, cutting to the front of a line to purchase the last few tickets to a show) ($M=5.74$, $SD=1.37$, $\alpha=.91$).

Spit Intentions

Spit intentions were measured using three-items created for the study. Participants were asked, “How much do you agree with the following” (1) I will not spit in public, (2) I will not spit around other people, and (3) I will not spit on the ground. Participants responded via a seven-point scale (*strongly disagree*, *disagree*, *somewhat disagree*, *neither agree nor disagree*, *somewhat agree*, *agree*, *strongly agree*) ($M=2.63$, $SD=1.67$, $\alpha=.88$).

Results

Bivariate Correlations

At the bivariate level, the disgust appeal was positively related to disgust (see Table 1). Democrats, females, and older adults had lower intentions to spit. Both pathogen and moral disgust were positively related to perceived disgust and negatively related to spit intentions. Perceived disgust was negatively related to spit intentions.

ANOVA

To address H1, H2, and RQ2, two ANOVAs were conducted with state-based disgust and spit intentions as outcomes and disgust appeal, education, and sex as fixed factors (see Table 2).

Regarding H1, ANOVA identified a significant effect of disgust appeal on state-based disgust, $F(1, 471)=19.21$, $p<.001$. State-based disgust was higher with the high disgust appeal compared to the low disgust appeal, supporting H1. Regarding H2, the disgust appeal did not have a significant effect on spit intentions, $F(1, 470)=0.62$, $p=.43$, rejecting H2.

Regarding RQ2, ANOVA identified a two-way interaction between the disgust appeal and education on spit intentions, $F(1, 470)=12.06$, $p<.001$. The high disgust message decreased spit intentions for those with more than a high school education. The low disgust message decreased spit intentions for those with a high school education or less (see Table 3). Although female participants had lower spit intentions, $F(1, 470)=59.18$, $p<.001$, participant sex did not moderate the impact of the disgust appeal.¹

Moderation: Dispositional Pathogen and Moral Disgust

To assess H3 and RQ1 assess, a path analysis program (PROCESS, Hayes, 2018) was utilized to test whether pathogen and moral disgust moderated the impact of disgust appeals on intention. To assess H3, two models were tested with disgust appeal as the independent variable and pathogen disgust as the moderator, with separate models for disgust and spit intentions as the dependent variable (see Appendix PROCESS model 1, see Hayes, 2018, p. 584). Both the disgust model, $R=.35$, $R^2=.12$, $MSE=3.18$, $F(3, 475)=21.67$, $p<.001$ and the spit intentions model, $R=.25$, $R^2=.06$, $MSE=2.64$, $F(3, 474)=10.70$, $p<.001$, significant. However, the disgust appeal x pathogen disgust interaction was not significant on state-based disgust, R^2 change = .0003, $F(1, 475)=0.14$, $p=.71$, or spit intentions R^2 change = .0001, $F(1, 474)=0.07$, $p=.79$, rejecting H3 (see Appendix for PROCESS output).

Regarding RQ1, two identical models were tested with moral disgust, instead of pathogen disgust, as the moderator. The models for disgust, $R=.29$, $R^2=.09$, $MSE=3.31$, $F(3, 475)=14.92$, $p<.001$, and for spit intentions were significant, $R=.17$, $R^2=.03$, $MSE=2.74$, $F(5, 474)=4.48$, $p<.001$. However, the disgust appeal x moral disgust interaction did

¹Sex did not significantly moderate any of the proposed relationships. Therefore, only education is reported as a moderator in subsequent sections.

Table 2. Main effects by message condition

	Perceived Disgust M (SD)	Spit Intentions M (SD)	N
Disgust Appeal			
Low Disgust Appeal	4.09 (1.91)	2.72 (1.72)	242
High Disgust Appeal	4.84 (1.81)	2.55 (1.62)	236
<i>F</i>	18.92***	.62	
Education			
High School or less	4.39 (1.97)	2.64 (1.66)	237
More than High School	4.53 (1.82)	2.62 (1.69)	241
<i>F</i>	.91	.03	
Sex			
Male	4.33 (1.84)	3.19 (1.72)	239
Female	4.60 (1.95)	2.07 (1.42)	239
<i>F</i>	1.82	59.18***	

Table 3. Disgust appeal × education interaction on spit intention

	High School or Less M (SD)	More than High School M (SD)
Disgust Appeal		
Low Disgust Appeal	2.47 (1.53)	2.95 (1.85)
High Disgust Appeal	2.81 (1.76)	2.28 (1.43)

Note: Means (M) and standard deviations (SD) by condition. Means that do not share a superscript are significantly different, $p < .01$.

not have a significant effect on disgust, R^2 change = .0000, $F(1, 475) = 0.002$, $p = .96$, or spit intentions, R^2 change = .0000, $F(1, 474) = 0.000$, $p = .91$ (see Appendix for PROCESS model 2 output).

Regarding RQ2, analyses were conducted to assess if education moderated the relationships proposed in H3 and RQ1 (see Appendix PROCESS model 3, see Hayes, 2018, p. 585). A three-way interaction emerged between disgust appeal, education, and moral disgust (but not pathogen disgust) on spit intentions. The model was significant, $R = .26$, $R^2 = .07$, $MSE = 2.65$, $F(7, 470) = 4.76$, $p < .001$, and the interaction was significant, R^2 change = .01, $F(1, 470) = 4.04$, $p = .045$. The high disgust message significantly reduced spit intentions for those with more than a high school education and low to moderate dispositional moral disgust (with low, moderate, and high levels of the moderator set at the 16th, 50th, and 84th percentile based on recommendations by Hayes, 2018). For those with a high school education or less, the low disgust message significantly reduced spit intentions for those with a high school education or less and low moral disgust (see Appendix for PROCESS output).

Mediation: Perceived Disgust

H4 was tested using two steps. First, a model was tested with disgust appeal as the independent variable, perceived disgust as the mediator and spit intentions as the outcome (PROCESS model 4, see Hayes, 2018, p. 585). The overall model was significant, $R = .32$, $R^2 = .10$, $MSE = 2.52$, $F(2, 475) = 26.82$, $p < .001$ (see Appendix for PROCESS output). A significant indirect path was observed through the perceived disgust, $R = -.21$, $Boot SE = .06$, 95% $CI: -.3296, -.1093$. The disgust appeal increased perceived disgust, $R = .75$, $SE = .17$, $p < .001$, which, in turn, was negatively related to spit intentions, $R = -.28$, $SE = .04$, $p < .001$, supporting H4a. Second, a moderated mediation model was tested, using dispositional pathogen disgust as a moderator (PROCESS model 8, see Hayes, 2018, p. 588). There was no evidence of moderated mediation, rejecting H4b (see Appendix for PROCESS output).

Regarding RQ1 and RQ2, post-hoc analyses identified conditional moderated mediation, whereby the indirect effect was jointly contingent on dispositional moral disgust and education, $index = .14$, $Boot SE = .06$, $CI = .0420, .2686$ (PROCESS model 18, see Hayes, 2018, p. 593). Interestingly, education and moral disgust moderated the association between state-based disgust and spit intention. The high disgust message decreased spit intentions for those with more than a high school education (with a stronger relationship at lower levels of moral disgust) and for those with a high school education or less who had moderate or high levels of dispositional moral disgust (see Appendix for PROCESS output).

Discussion

The addition of a spit visual to an anti-spitting message triggered increased state-based disgust in US adults and indirectly decreased spit intentions. For those with more than a high school education, the high visual disgust appeal directly decreased intentions, a relationship that was magnified by moral disgust increased. The findings highlight a number of important implications for parasite stress theory in the context of anti-spitting messaging.

Parasite stress theory posits that individuals with higher levels of dispositional disgust will respond more strongly to disgusting stimuli (Tybur, Lieberman, & Griskevicius, 2009). Further, data were collected during a pandemic which parasite stress theory claims should heighten sensitivity to virus-related stimuli. Yet, dispositional pathogen disgust did not moderate responses to the disgust appeal. For those high in dispositional disgust, a lower threshold for disgust may exist – particularly during pandemic times – meaning they will be equally affected by low and high pathogen or moral disgust messages. This supposition is supported by the correlations between pathogen and moral disgust and both state-based disgust and spit intentions. Regardless of message, individuals with higher levels of dispositional disgust were more likely to experience disgust and had lower spit intentions. Importantly, the COVID-19 pandemic may have shifted virus-relevant behaviors into a moral, rather than a pathogen, domain. COVID-19 prevention behaviors have been laden with

moral judgments, such as the importance of avoiding harming others (Díaz & Cova, 2021). This could explain why moral, rather than pathogen, disgust served as a moderator.

Prior research indicates that disgust appeals (often moral) typically affect the most psychologically or socially vulnerable populations; those who feel disempowered, distressed, or are socioeconomically disadvantaged (Hastings, Stead, & Webb, 2004; Van't Riet & Ruiter, 2013). Consequently, those populations with a high school education or less would be expected to respond most strongly to campaigns high in disgust, as a “pedagogy of disgust” (Lupton, 2015) suggests that using images or powerful messages evokes intense emotional responses in audiences resistant to public health messages. Contrary to this idea, in the current study respondents with a high school education or less were persuaded by stimuli low in state-based disgust. Specifically, the high state-based disgust message decreased spit intentions for those with more than a high school education, whereas the low state-based disgust message decreased spit intentions for those with a high school education or less. This relationship cannot be explained by perceived disgust, as the two groups did not significantly differ in feelings of perceived disgust. Moreover, no other demographic differences were found to be a significant factor. Across our full study cohort, spitting may be considered disgusting regardless of education level. Future research should explore why those with a high school education or less preferred stimuli low in disgust. Psychological reactance theory could shed light on these differences (Díaz & Cova, 2021). More broadly, future research must explicate the ways in which educational status does – and does not – modify perceived disgust and behavioral intentions with other behaviors or in alternate contexts.

Spitting remains ubiquitous in various regions around the globe, and it has been argued that anti-spitting campaigns reflect globalization and the pressures to conform to western norms (Coomber, Moyle, & Pavlidis, 2018; Kar, Pandey, & Singh, 2020). There have been laws or ordinances put in place internationally to curb the behavior. Yet, voluntary spitting is sometimes positioned as a pleasure-generating behavior (Gomberg, 1981), especially in countries like India and China. Spitting may also have cultural value and meaning like shopkeepers in India spitting on cash on the first sale as a way to repress bad luck (Kar, Pandey, & Singh, 2020). Similar to the history of the US, in India and China spitting is often viewed as less civilized and a working-class low education habit (Kar, Pandey, & Singh, 2020) and may explain why higher education participants consistently responded in line with the disgust appeal. Anti-spitting messages and campaigns should consider education level and try to avoid paternalistic messages to avoid evoking reactance, defensiveness, anger, retreatment, guilt, and despondency (Lupton, 2015).

Limitations

The current study was limited in several ways. First, the current study was carried out in the fall of 2020 during the COVID-19

pandemic. The results may be contingent on the presence of the pandemic or the particular time period of data collection. Second, while anti-spitting campaigns were present globally during the pandemic, they were less common in the US. Despite historical precedent, public health campaigns opted to focus on other behaviors during the COVID-19 pandemic. Third, the measure of spitting intentions was developed for the current study. A validated measure of spitting behaviors would benefit researchers working on this topic across different fields. Fourth, the current study captured between-person differences in response to low and high disgust appeals. A within-participant study design could add nuance in understanding responses to low disgust appeals by providing a disgust baseline for comparison.

Conclusion

During pandemics, public health entities have historically utilized disgust-focused anti-spitting campaigns to influence public behavior. The results of the current study suggest that high state-based disgust anti-spit messages positively impact individuals with more than a high school education, whereas low state-based disgust messages seem to influence those with a high school education or less. Given the importance of public messaging during pandemics, future research should continue to examine the efficacy and theoretical underpinnings of varied disgust appeals.

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Data availability statement

Data were generated by University of Utah and are available upon reasonable request.

Supplementary material

Supplemental data for this article can be accessed online at <https://doi.org/10.1080/10810730.2023.2229772>

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