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Cover your mouth! Disease avoidance predicts the stigmatization of yawning

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ABSTRACT

Despite presenting several physiological and social benefits, yawning remains a highly stigmatized behavior across various cultures. Given evidence for an association between illness and the proclivity to yawn, it could be possible that yawning provides a heuristic cue to disease transmission between conspecifics. This aversion to yawning could thus serve as a disease avoidance strategy. The current study identified how individual differences in disease avoidance motivations could foster stigmatization of yawning. Participants completed personality inventories, including those related to disease avoidance and disgust, while indicating their attitudes toward various bodily functions. Individual differences in germ aversion and pathogen disgust were particularly associated with stigmatization of yawning, such that higher levels of these traits fostered greater aversion toward yawning. These data provide initial evidence for how fundamental social motives can facilitate reactions to involuntary behaviors.

1. Introduction

Yawning is a stereotyped action pattern observed across vertebrate species (Baenninger, 1987). Recent large-scale comparative analyses suggest that yawning is a neurological adaptation that has been evolutionarily conserved across amniote evolution (Massen et al., 2021). Although this behavior can be observed across the day, often in 6-s intervals, the majority of yawning events occur shortly after waking in the morning and prior to sleep onset in the evening (Baenninger et al., 1996; Gallup et al., 2016; Zilli et al., 2007). Yawning is therefore typically associated with sleepiness and fatigue (Provine et al., 1987) and appears to function in promoting state change, cortical arousal, and thermoregulation (Gallup, 2022).

Despite its involuntary nature and adaptive significance, paradoxically, yawning in the presence of other people is often stigmatized. Yawning is offensive in social settings across various cultures (Schiller, 2002). Perhaps as a result, in the United States, spontaneous yawning is noted as uncommon among people in crowded environments (Baenninger, 1987) and when being observed in laboratory settings (Baenninger & Greco, 1991). Similar social presence effects have also been observed for yawn contagion, the reflexive tendency to yawn following the detection of yawns in others that is common in humans and some non-human animals (Anderson et al., 2004; Gallup et al., 2015; Provine, 1986). Laboratory research has shown that participants are less likely to display yawn contagion both when in the presence of a researcher and when informed that they were being recorded during testing (Gallup et al., 2016). The dampening effect of real-life social presence also inhibits yawn contagion triggered within virtual reality (VR; Gallup et al., 2019). That is, yawning in response to contagion stimuli presented in VR was reduced by the known presence of a live researcher during testing even though participants were immersed in simulated environments and unable to see this individual. This research sought to understand the motivational underpinnings of yawning stigmatization.

1.1. The stigma of yawning

It is common to cover one's mouth during a yawn to conceal the action in many regions of the world in the process of others. In Italy, for example, most individuals cover their mouth while yawning (Schino & Aureli, 1989). This practice has become so prevalent in the United Kingdom, computer vision software has been developed to detect indicators of fatigue among drivers, such as yawning, to address mouth occlusion by the hand (Ibrahim et al., 2015). Moreover, laboratory research in the United States has identified the social nature of covering

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yawns. For example, administration of intranasal oxytocin, a neuropeptide known to increase social perception and awareness (Bartz et al., 2011), leads to concealing and stifling yawn contagion and concomitant behaviors (e.g., bodily stretching, sighs; Gallup & Church, 2015).

Research has begun considering factors that could contribute to a pervasive stigmatization of yawning in social settings. One potential explanation is that yawns connote drowsiness, given the temporal association between yawning and sleep/wake cycles (Baenninger et al., 1996; Provine et al., 1987; Zilli et al., 2007). The susceptibility to yawn in response to video stimuli is also predicted by self-reported tiredness (Gallup et al., 2021). Yawning further increases under conditions of reduced stimulation and boredom (Provine & Hamernik, 1986), which could be perceived as disrespectful. However, yawning can also occur across situations that cannot be explained by fatigue or boredom, such as among Olympic athletes just moments prior to competition (Provine, 2005). Moreover, these associations may not explain the tendency to cover one's mouth while yawning. Although seemingly polite, covering the mouth while yawning could draw even more attention to an objectionable behavior.

An alternative explanation for the stigma and social etiquette associated with yawning could be its connection with disease (Walusinski, 2010a). Abnormal or excessive yawning occurs across numerous medical conditions, including neurological diseases, iatrogenic pathologies, and various infections (Birca et al., 2020; Daquin et al., 2001; Gallup & Gallup, 2008; Walusinski, 2009). Yawning additionally accompanies and precedes fever, which could be a sign of disease (Walusinski, 2010b). Moreover, when administered the bacterial endotoxin lipopolysaccharide to activate an immunological response (i.e., sickness), participants' body temperature and yawn frequency significantly increased 1–2 h thereafter (Marraffa et al., 2017).

Historical renderings of yawning also show commonality in representing it as a weakness of the bodily system. Records exist drawing a connection between yawning and the bubonic plague in Europe (590 CE) akin to modern customs of concealment and negative perceptions of yawning (Walusinski, 2010b).

> "Yawning was fatal then, and the habit of signing the cross in front of the mouth originated during the times of the plague…Their souls left their bodies when they sneezed or yawned. This is why we said 'God bless you' to those who sneezed. Those who yawned made the sign of the cross over their mouths." (Le Camus, 1769; p. 477).

The practice of covering one's mouth while yawning in the presence of others could thus be derived from connections to large-scale disease transmission, originating prior to the plague.

1.2. Stigmatization as a disease avoidance strategy

This perceived association between yawning and disease could be especially apparent when disease is salient, thus heightening stigmatization of yawning in the service of mitigating contact with potential disease vectors. In addition to physiological responses to pathogenic threats, it has been argued that a concomitant behavioral immune system evolved to identify pathogenic threats prior to infection that motivates aversion to these threats (Murray & Schaller, 2016; Murray et al., 2011). Acute activation of disease avoidance responses fosters interpersonal reticence (Brown & Sacco, 2020; Mortensen et al., 2010). This reticence can manifest as stigmatization toward behaviors that would have historically increased group vulnerability to infection, often eliciting a disgust response (Oaten et al., 2009).

Deviation from group rules could implicate someone as a pathogenic threat, as such deviations suggest a disinterest adhering to norms that could mitigate disease transmission. Such aversion to nonconformity has been observed in both laboratory (Brown, 2021; Murray & Schaller, 2012; Wu & Chang, 2012) and cross-cultural research (Murray et al., 2011). Adherence to group rules is further codified as moral imperatives, with disease avoidance motives fostering restrictive behaviors as central to individuals' morality and providing a basis for punitive decisions (Brown et al., 2017; Makhanova et al., 2019). Feelings of disgust toward pathogenic cues are further predictive of stigmatization toward individuals experiencing mental illness (Dawydiak et al., 2020). These findings suggest that avoidance motives could foster similar attitudes toward yawning given its ostensible connotation of disease.

Recent findings have demonstrated that disease avoidance motives can be downregulated in favor of satisfying orthogonal motives, particularly to secure social opportunities. Exclusionary experiences reduce concerns of infectious diseases (Sacco et al., 2014) and heighten interest in affiliative opportunities that could increase exposure to disease threats (e.g., extraverts; Brown, Keefer, et al., 2019). In the latter case, the risk of infection was less salient than the benefits of affiliation. Chronically heightened affiliative motives have further been implicated in predicting interests in social behavior that would be otherwise risky during the height of the COVID-19 pandemic (Brown et al., 2021). The salience of affiliative concerns may further downregulate perceivers' judiciousness toward stigmatized social behaviors in the service of widening their available social network.

1.3. Current research

Based on this previous literature showing that frequent yawning is linked to fatigue and various medical conditions (Walusinski, 2010a; Daquin et al., 2001), this study examined whether yawning represents a disease cue. This led us to consider the association between various components of disease avoidance, through disgust and perceived vulnerability to disease, to assess which were most predictive of stigmatization of yawning. Conversely, the fact that heightened affiliative motives reduce motivations to avoid disease led us to predict that need to belong would attenuate this stigmatization. We also compared how the stigmatization of yawning compared with negative perceptions of putative indicators of disease (i.e., sneezing and coughing). Data and study materials are for this study are available at: https://osf.io/aqjxs/

2. Method

2.1. Participants

We recruited 196 undergraduates from a large public university in Southeastern U.S. in exchange for course credit (117 women, 79 men; $M_{Age} = 19.27$, $SD = 2.15$). Participants were recruited using an online participant pool for a remote study. A sensitivity analysis indicated we were adequately powered to detect small effects for a cross-sectional correlational research design ($\rho = 0.19$, $1\text{-}\beta = 0.80$).

2.2. Material and procedure

2.2.1. Disease avoidance

Participants indicated individual differences in their dispositional motivation to avoid disease using the Perceived Vulnerability to Disease Scale (Duncan et al., 2009). This 15-item measure operates along 7-point scales (1 = *Strongly Disagree*; 7 = *Strongly Agree*). Two subscales exist in this measure that reflect both the motivational component of disease avoidance in Germ Aversion (GA) and the cognitive component in Perceived Infectability (PI). The modest correlation between these subscales ($r = 0.17$, $p = 0.015$) necessitated us to consider them separately. See Table 1 for relevant descriptive statistics.

2.2.2. Disgust

We assessed individual differences in the experience of disgust using the Three Domains of Disgust Scale (Tybur et al., 2009). This measure is comprised of three subscales assessing different domains that would elicit functional disgust response toward aversive stimuli: pathogen,

Table 1
Descriptive statistics, reliabilities, and correlations among study variables.

	Sneezing	Coughing	Yawning	Hiccups	α	*M*(*SD*)
GA	0.31**	0.27**	0.34**	0.32**	0.63	3.83 (0.90)
PI	−0.10	−0.02	0.11	0.02	0.88	3.50 (1.22)
Moral	0.21**	0.18*	0.21**	0.11	0.83	4.76 (1.14)
Sexual	0.11	0.12	0.13	−0.04	0.82	4.55 (1.30)
Pathogen	0.28**	0.29**	0.29**	0.15*	0.72	5.08 (0.93)
COVID-19 Fear	0.18*	0.12	0.14*	0.16*	0.88	1.76 (0.67)
NTB	0.01	−0.02	0.01	−0.07	0.78	4.46 (0.94)
Extraversion	−0.09	−0.17*	0.03	−0.11	0.83	3.24 (0.95)
Agreeableness	0.04	0.07	0.00	−0.09	0.72	3.73 (0.73)
Conscientiousness	0.14*	0.15*	0.06	0.01	0.65	3.35 (0.78)
Neuroticism	0.00	0.03	0.06	0.10	0.62	2.93 (0.77)
Openness	−0.02	−0.05	−0.08	−0.11	0.72	3.66 (0.74)
α	0.39	0.47	0.76	0.57	–	–
M(*SD*)	7.20 (1.67)	7.33 (1.77)	5.85 (2.70)	4.04 (2.14)	–	–

Note. GA = Germ Aversion, PI = Perceived Infectability, Moral = Moral Disgust, Sexual = Sexual Disgust, Pathogen = Pathogen Disgust, NTB = Need to Belong.
* $p < 0.05$.
** $p < 0.01$.

sexual, and moral disgust. Considering all three subscales afforded an understanding of the boundary conditions in disgust responses. This 21-item scale operated along 7-point scales (1 = *Not at All Disgusting*; 7 = *Extremely Disgusting*).

2.2.3. Fear of COVID-19

We assessed individual differences in fear of COVID-19 to provide a corollary to a present-day disease threat to which humans did not evolve (Ackerman et al., 2021). That is, this measure afforded us the opportunity to determine whether potential stigmatization of bodily functions is based in ancestrally derived functions, or a byproduct of this study being conducted during a pandemic. Participants responded to a 7-item measure operating along 5-point scales (1 = *Strong Disagree*; 5 = *Strongly Agree*; Ahorsu et al., 2020).

2.2.4. Affiliative motives

To identify a motivational underpinning of for how affiliative motives could mitigate an aversion to bodily functions, we assessed individual differences in affiliative motives using the Need to Belong Scale (Leary et al., 2013). This 10-item measure operates along 7-point scales (1 = *Strongly Disagree*; 7 = *Strongly Agree*).

2.2.5. Big five

Additional analyses considered the extent Big Five personality traits were associated with these stigmas. We employed the 20-item version of a Big Five Inventory, with four items for each trait (Goldberg, 1992). Items operated along 7-point scales (1 = *Very Inaccurate*; 7 = *Very Accurate*).

2.2.6. Social stigma

As our critical outcome variable, participants indicated their attitudes toward four bodily functions. We chose two functions that are putative cues to disease (i.e., sneezing, coughing), given that both are capable of disease transmission. In addition to yawning, a function we hypothesized to have a heuristic association with disease, we included stigma toward hiccups as a control function with no heuristic association with disease.

Items operated along 11-point scales (1 = *Do Not Agree at All*; 11 = *Completely Agree*). High scores reflect agreement about the bodily function as stigmatizing. We used three items per function: (1) It is rude or disrespectful to [yawn] in the presence of other people; (2) If someone has to [yawn] in a social setting, they should cover mouth; (3) In social settings, I try to stifle or conceal my [yawns] so other people do not notice. It should be noted that the reliability coefficients for sneezing, coughing, and hiccups are below the threshold of what is considered adequate reliability. Nonetheless, the theoretical consistency between these items for each function, and the acceptable reliability for yawning, led us to aggregate these items.

3. Results

3.1. Preliminary analysis

We first determined potential differences in stigmatization toward sneezing, coughing, yawning, and hiccupping using a one-way repeated ANOVA with each function as a level for the within-subjects factor. Greenhouse-Geisser corrections were employed following violations of sphericity. A main effect emerged, $F(2.44, 477.07) = 160.09$, $p < 0.001$, $\eta_p^2 = 0.451$.

Post hoc LSD tests indicated that coughing was the most stigmatized function, followed by sneezing, then yawning, and finally hiccups. The difference between sneezing and coughing was not significant ($p = 0.209$, $d = 0.15$). All other differences were significant ($ps < 0.001$, $ds > 0.47$). Yawning appears more stigmatized than other functions less heuristically associated with disease, though not as stigmatizing as putative cues to disease.

Correlational Analyses.

We conducted bivariate correlations to identify the motivational and personality bases of stigma toward each function (see Table 1). GA was associated with greater stigmatization of all bodily functions, with correlations being similar magnitudes. PI was unrelated to all forms of stigmatization. Fear of COVID-19 was associated with greater stigmatization of sneezing, yawning, and hiccups, albeit at small magnitudes, but not coughing.

Moral disgust was associated with greater stigma toward sneezes, coughs, and yawns, but not hiccups; the significant correlations were similar magnitudes. A similar pattern of results emerged for pathogen disgust at larger magnitudes for sneezing, coughing, and yawning; the correlation for hiccups was significant at a smaller magnitude. No effects emerged for sexual disgust. Need to belong was unassociated with any form of stigmatization.

For the Big Five, we found a negative correlation between extraversion and stigmatization of coughing. Extraverted individuals stigmatized coughing less. Conscientiousness was associated with greater stigmatization of sneezing and coughing. No other associations emerged for the Big Five.

3.2. Regression analyses

Our final step was to determine which components of disease avoidance were most predictive of stigmatization. We submitted GA and pathogen disgust into a multiple regression for each function as an

outcome; fear of COVID-19 was entered in three of four models because it did not correlate with aversion to coughing.

In the coughing model, both GA and pathogen disgust predicted stigmatization. When considering the three predictors for sneezing and yawning, GA and pathogen disgust are the only predictors that remained significant. With the same three predictors as the previous analysis for hiccups, only GA remained significant (see Table 2).

4. Discussion

This study represents an initial investigation of the underpinnings for the stigmatization of yawning in the presence of others using a social motives framework. Data support our hypotheses related to disease avoidance, such that germ aversion and pathogen disgust were especially predictive of aversion to bodily functions that included yawning. Germ aversion is a motivational component of disease avoidance responses, which often relies on liberal criteria for what constitutes a disease cue, even if such cues do not represent actual risk of infection (e.g., Makhanova et al., in press; Brown, Sacco, & Medlin, 2019). The similar magnitudes of the effects for each bodily function, regardless of whether it was a putative cue to infection, suggests that bodily functions elicit a heuristic association with disease transmission. When paired with the results indicating that yawning is stigmatized to a much greater degree than hiccups, albeit not as much as putative cues, these effects suggest that yawning is inferred as a pathogenic cue. Perceived infectability's lack of predictive power was additionally unsurprising, given its function as a more cognitive component of disease avoidance that may only serve to identify disease cues (Brown & Sacco, 2016).

Given that we conducted this study during the COVID-19 pandemic, we assessed individual differences in fear of COVID-19 specifically. Although this fear was associated with greater stigmatization of yawning, it should be noted that these effects were small and ultimately nonsignificant when simultaneously regressing germ aversion and pathogen disgust in the model. This could reflect a general mismatch between the ancestral environment wherein disease avoidance motives evolved and a global pandemic. That is, humans' behavioral immune system responses would have been specific to local ecologies and proximal cues of disease rather than distal cues reported by the media that would have less immediate salience (Ackerman et al., 2021). This lack of finding could provide evidence that yawning stigmatization does have ancestral roots when considering disease transmission in historical contexts (Walusinski, 2010b).

The consistent associations between pathogen disgust and the aversion to each bodily function provide further evidence for an emotional component to the disease avoidance function of yawning stigmatization. A common underpinning for the stigmatization of marginalized groups is often pathogen disgust, which could function to mitigate contact with those exhibiting non-normative behavior (Dawydiak et al., 2020). Albeit less consistent and at smaller magnitudes, moral disgust was predictive of bodily functions, which included yawning. These associations could represent the codification of restricting pathogenically threatening behavior, which could reflect negative attitudes toward unconcealed yawns (Schiller, 2002; Walusinski, 2010b). The lack of effects for sexual disgust provides evidence for domain-specificity, as yawns may not indicate a threat of sexually transmitted infections.

Affiliative motives and general personality factors were relatively unrelated to negative perceptions of these bodily functions. The lack of effects for need to belong could reflect a louder signal value for these bodily functions in connoting disease that chronic affiliative motives would not be able to downregulate this aversion. Interestingly, conscientiousness was associated with stigma for sneezing and coughing, which likely reflects conscientious individuals' orderliness that could leave them less vulnerable to infection (Bogg & Roberts, 2004; Duncan et al., 2009). Conversely, measures of extraversion were negatively associated with stigma for coughing. These findings align with previous work suggesting that disease threats downregulate self-reported extraversion in the service of minimizing the interpersonal contact requisite for disease transmission (Mortensen et al., 2010). The desire for interpersonal contact among extraverted individuals could have downregulated their aversion to putative disease cues (Sacco et al., 2014).

Table 2
Regression analyses for each outcome with components of disease avoidance.

	Sneezing	Coughing	Yawning	Hiccups
GA	0.21 (0.14)*	0.19 (0.14)*	0.25 (0.22)*	0.27 (0.18)*
Pathogen	0.20 (0.13)*	0.23 (0.14)*	0.20 (0.21)*	0.05 (0.17)
COVID-19 Fear	0.12 (0.17)	–	0.08 (0.27)	0.09 (0.22)
Model R^2	0.14	0.12	0.15	0.11

Notes. Dashes indicate a predictor not included in the specific model due to lack of significance in the bivariate correlations. Reported coefficients are standardized (with standard error).

* $p < 0.01$.

4.1. Limitations and future directions

There are important limitations to this study that necessitate future research. First, the self-report nature of this research could lead to self-reporting bias. Measurements of behavioral change toward yawning in laboratory or natural settings would complement these findings. A desire to understand naturalistic settings could invite cross-cultural research on the reported effects, which could afford a richer understanding in different conceptualizations of yawning. Although yawns appear to be more clearly implicated in disease among Western cultures, individuals in India and Arab countries regard yawning as the entrance of evil spirits into the mouth (see Walusinski, 2010b). This could reflect various inputs into the stigmatization of yawning, with future cross-cultural studies employing measures of magical thinking as a predictor of stigmatization (Nemeroff & Rozin, 2000).

The correlational nature of our findings also necessitates future research utilizing experimental methods. Studies could employ disease primes to activate pathogen-avoidant motives in participants (e.g., Brown & Sacco, 2020). These priming experiments could then task participants to evaluate the ostensibly poor health of yawning targets or have researchers identify avoidant behavior while interacting with a yawning confederate. Conversely, research could consider how disease salience potentially motivates individuals to stifle their yawns in social settings (e.g., interdependent group tasks) due to an implicit knowledge of the stigmatization surrounding yawns (Baenninger, 1987).

The extant literature is also less clear about the communicative value of yawning. That is, research would benefit from considering whether this disease-based stigma of yawning is rooted in a heuristic of poor health from fatigue (Watt et al., 2000), or represents an understanding that yawning is putatively diagnostic of disease (Walusinski, 2009). Future research could infect participants with a communicable disease to induce yawning (Marraffa et al., 2017), with these behaviors being recorded for evaluation by third-person perceivers and compared to evaluations of people imitating the behaviors of yawning. Given the relative acuity individuals have in identifying infection risks in these thin slices of information (Axelsson et al., 2018; Regenbogen et al., 2017), it is possible that yawning following an infection would be particularly aversive.

5. Conclusion

Yawning is an evolutionarily old behavior that appears to have important functionality both physiologically and socially (Casetta et al., 2021; Gallup & Meyers, 2021; Massen et al., 2021). Nonetheless, yawning carries as stigma insofar as people stifle their yawns both spontaneously and contagiously when social evaluations could be salient (Baenninger, 1987; Baenninger et al., 1996; Gallup et al., 2016, 2019). The current study represents a potential basis for this general

stigmatization in the form of disease avoidance, with chronic disease concern leading individuals to evaluate yawns as a heuristic disease threat. This association may prove fruitful in understanding the cross-cultural ambivalence of yawning in future research.

CRediT authorship contribution statement

Mitch Brown was involved in the conceptualization and implementation of this study. He further conducted the primary analyses and provided an initial draft of the manuscript with subsequent revisions.

Andrew C. Gallup was involved in the conceptualization of this study and developed the outcome measure. He contributed substantive revisions to the initial draft.

Samuel E. Snowden was involved in programming the study and provided necessary revisions to the manuscript.

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