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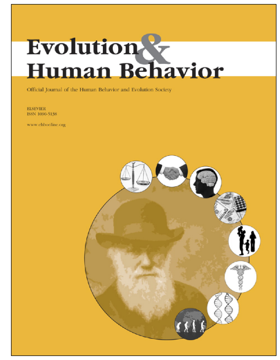

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The Behavioral Immune System is Designed to Avoid Infected Individuals, Not Outgroups

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Abstract

What is the adapted structure of the behavioral immune system? By definition, the behavioral immune system motivates pathogen avoidance. One prominent suggestion is that the behavioral immune system also contains an additional component that generates motivation to avoid individuals from unfamiliar outgroups. The evolvability of this component has recently been questioned, however, and it has been noted that all supportive evidence stems from WEIRD samples. In this paper, we conducted between-subject experiments in large samples of adult residents of the USA (N = 1615) and India (N = 1969). In the experiment, we measured comfort with physical contact with a depicted individual. The individual was either from an ethnic ingroup or outgroup and either showed a pathogen cue or not. Results were inconsistent with the view that the behavioral immune system motivates the avoidance of individuals from unfamiliar outgroups. Instead, the results strongly supported that the system simply motivates the avoidance of any infected individual regardless of their group membership.

behavioral immune system; pathogen avoidance; disgust; social cognition; stigma; prejudice

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1. Introduction

There is increasing attention to the possibility that feelings of antipathy toward individuals with particular features are driven by psychological mechanisms for avoiding pathogens (Kurzban & Leary, 2001). For example, there is substantial evidence that obesity stigma is partly driven by pathogen-avoidance mechanisms (Van Leeuwen, Hunt, & Park, 2015) and that prejudice toward homosexuals is elevated among individuals with elevated pathogen concerns (Inbar, Pizarro, Knobe, & Bloom, 2009). Over the last 15 years, these and other lines of research have been drawn together in support of the notion that humans have a behavioral immune system. This system is the collection of psychological mechanisms that enables individuals to detect pathogens in their environment and motivate behaviors that prevent these pathogens from entering the body (Murray & Schaller, 2016; Schaller, 2006; Schaller & Park, 2011).

The current question is not whether there is a behavioral immune system but rather how it works. Some features of this system are well-established; for example, there is now substantial evidence that one of the core outputs of the system is disgust, an emotion geared toward the avoidance of pathogens (Curtis, De Barra, & Augner, 2011; Oaten, Stevenson, & Case, 2009; Tybur, Lieberman, Kurzban, & DeScioli, 2013). Research has also convincingly demonstrated that people vary in their propensity to feel disgust in the face of pathogens and, hence, there seem to be individual differences in the sensitivity of the behavioral immune system (Tybur, Lieberman, & Griskevicius, 2009). Other potential features of the system are less well-established. This paper focuses on one such feature, which has played a prominent role in some past research: whether the behavioral immune system is adapted by natural selection to utilize group membership cues as input and, more generally, whether antipathy toward individuals from different races, ethnic groups, and foreign countries is an adapted response to pathogen-avoidance motivations.

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Stigmatization and aggression toward ethnic minorities are sometimes accompanied by claims that such groups carry contagious diseases (e.g., Oaten, Stevenson, & Case, 2011), and different lines of research have argued that prejudice toward outgroups might be an output of the behavioral immune system. For example, one study among Canadian students found that those indicating greater concern with catching a contagious disease were more likely to oppose people from an unfamiliar African country immigrating into Canada (Faulkner et al., 2004, Study 2). In another study among Canadian students (Faulkner et al., 2004, Study 6), anti-immigration attitudes were measured by asking participants how to allocate a government budget to recruit immigrants from several countries. Some of the countries were known to be unfamiliar to the sample of participants (e.g. Nigeria, Mongolia), whereas others were known to be familiar (e.g. Scotland, Taiwan). The study involved two conditions: in the control condition, participants watched a series of photos that made them think about the risk of accidents, whereas in the test condition they watched a series of photos that made them think about the risk of contagious diseases. On average, participants that had seen the photos of contagious diseases allocated less of the government budget to recruiting immigrants from unfamiliar countries. Several studies with other Western (mostly American) samples have produced similar observations: motivations to avoid pathogens have repeatedly predicted opposition to immigration (Faulkner et al., 2004, Studies 3, 4, 5; Aarøe, Osmundsen, & Petersen, 2016, Study 3; Aarøe, Petersen, & Arceneaux, 2017) and ethnocentrism (Navarrete & Fessler, 2006; Naverret, Fessler, & Eng, 2007). Recent studies have extended this argument. In a series of studies of the effects of vaccination on outgroup prejudice, Huang et al. (2011) found that if an experimental manipulation had made the risks of contamination salient, the participants who were more motivated to avoid pathogens expressed more negative attitudes toward various outgroups (e.g., homeless, illegal immigrants, Muslims).

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Finally, at least three studies have attempted to assess the association between pathogen-avoidance motivations and antipathy toward individuals from foreign countries while not using an explicit measure of antipathy. Faulkner et al. (2004, Study 1) reported a correlation between pathogen concerns and implicitly associating Africans more strongly with danger than with safety (measured with an implicit association test).[1] Miller and Maner (2012) reported studies with a signal detection paradigm. In such a paradigm, participants are presented with a series of pictures and asked to indicate when they see a certain feature. For example, for each photo they must indicate whether the person in the photo is young or old. One study using such a paradigm (Miller & Maner, 2012, Study 4) found that participants who were more concerned about contagious disease set a lower threshold for indicating that they had seen an old person when the people in the photos were from another ethnic group (i.e. Asian). Assuming that participants associated old age with disease, this finding was interpreted as supporting the notion that they had associated the foreign ethnicity (Asian) with disease. Finally, an analysis of international air travel showed that immediately after the 2009 outbreak of so-called swine flu (H1N1 influenza virus), international air travel declined more in East Asia than in Europe and North America (Hamamura & Park, 2010). Combined with survey data showing that East Asian individuals are more concerned with being infected by foreign individuals than Western individuals, the reduced international travel in East Asia was interpreted as consistent with East Asians having an increased tendency to avoid foreign individuals when pathogen risks are salient.

The crucial question raised in this paper is regarding the kinds of inferences that can be drawn about the structure of the behavioral immune system from such observations. A number of studies have inferred that antipathy toward individuals of a different ethnic outgroup is an *adaptive* outcome of the behavioral immune system (Faulkner et al., 2004;

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[1] This finding is tentative because pathogen concerns did not predict whether participants associated Africans with unpleasant.

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Fincher & Thornhill, 2012; Thornhill & Fincher, 2014, pp. 59–63; Tybur, Merriman, Hooper, McDonald, & Navarrete, 2010). The argument is that negative affect (including avoidance motivations) toward individuals from ethnic outgroups is a functional behavior produced by the behavioral immune system because individuals from such other groups might carry pathogens that the ingroup has yet to acquire immunity against. A canonical example from recent history testifying to this possibility is the European conquest of the Americas, where 90% of the native population was killed by a smallpox virus that the Europeans brought with them. Potentially, such recurrent situations have selected for mechanisms in the behavioral immune system to avoid members who are perceived as being from an outgroup (i.e., "not from my ethnic group" or "foreign"). In other words, according to this view, the behavioral immune system contains perceptual mechanisms for which some features that correlate with outgroup membership are part of the proper domain (Barrett & Kurzban, 2006; Sperber, 1994): the behavioral immune system includes evolved design *for* responding to features that correlate with outgroup membership. We will refer to the theory that the behavioral immune system includes design for avoiding outgroup individuals as the *adaptation-for-groups* account.

Yet while the association between outgroup prejudice and pathogen-avoidance motivations appears robust from previous studies (for a meta-analysis of published findings, see Aarøe et al., 2017), we believe that there is reason to pause when interpreting them. Specifically, we believe that the adaptation-for-groups account faces unresolved problems that are both theoretical and empirical in nature.

Theoretically, at least two arguments speak against the notion that the behavioral immune system is adapted to avoid outgroups (Fessler, Clark, & Clint, 2015; see also Aarøe et al., 2016). First, ancestral humans were unlikely to have interacted regularly with individuals from outgroups that were so unfamiliar that their pathogens were especially

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harmful. Ancestral humans generally traveled on foot and were therefore unlikely to meet individuals of entirely foreign ethnic groups; that is, they might have interacted with individuals of neighboring bands and tribes, but such encounters would only extremely rarely constitute a first contact between previously isolated societies (e.g., they would virtually never encounter humans from other continents). Therefore, it does not matter whether the co-evolution of pathogens and humans makes the novel pathogens of separated groups especially harmful or harmless (de Barra & Curtis, 2012). When ancestral humans interacted with outgroup individuals, this was unlikely to expose them to novel pathogens. From this perspective, the pathogen risks posed by interactions with outgroup and ingroup individuals were similar. Consistent with this, Aarøe et al. (2016) report that higher pathogen-avoidance motivations predict lower trust toward both outgroup and ingroup members. This suggests that there was no selection for behavioral immune system mechanisms that motivate avoidance based on cues that someone belongs to an outgroup.

Second, avoiding outgroup individuals was unlikely to reduce the costs suffered from pathogenic infection. Fessler et al. (2015) argued that with respect to highly transmissible diseases, if a single member of one's band catches it, all of the others risk infection. Presumably, individuals who were *not* avoidant of outgroup individuals were exposed to outgroup pathogens while also gaining some benefits from interacting with outgroup individuals (e.g., mating). Assuming a high transmissibility of diseases within bands, however, individuals who avoided outgroup individuals were nevertheless exposed to outgroup pathogens while not gaining any benefits from interacting with outgroup individuals (while the evidence of this is limited in humans, there is evidence from giraffe social networks; see Vanderwaal et al., 2016). In other words, avoiding outgroups did not keep one safe from infection and reduced the benefits of social interaction. The higher net costs for those who avoided contact with outgroup individuals suggest that it is unlikely that there was

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selection for behavioral immune system mechanisms specifically motivating outgroup avoidance.

In addition to these theoretical problems, we want to raise three empirical problems that characterize the existing literature promoting the notion that the association between outgroup prejudice and pathogen-avoidance motivations reflects an adaptive response. First, some of the findings that have been interpreted as supporting the adaptation-for-groups account do not provide strong evidence. Some studies finding associations between pathogen concerns and antipathy toward outgroups could be confounded by participants' explicit beliefs. Specifically, rather than outgroup status per se, the results might be caused by beliefs (e.g., generated by news stories, stereotypes, or experiences) that these specific groups (e.g. Nigerians in Faulkner et al., 2004; illegal immigrants in Huang et al., 2011; foreigners in Hamamura & Park, 2010) have higher pathogen prevalence. Was this the case, people's attitudes toward social contact would track learned information about pathogen risks and not that humans infer pathogen risks strictly based on outgroup membership cues. Without addressing this confound, it is difficult to count such studies as evidence of the adaptation-for-groups account. The findings could be accounted for by a behavioral immune system designed for pathogen avoidance without design for avoiding outgroups per se (we elaborate on this in section 5 Discussion).

Second, as hinted at in the above, almost all tests have been conducted on populations that live up to the WEIRD acronym (Western Educated Industrialized Rich Democratic; see Henrich, Heine & Norenzayan, 2010); hence, limited evidence exists that can reveal whether the association generalizes to non-White, non-Western populations in which White Westerners are seen as members of an outgroup. If the association rests on an adaptation, then this should, ceteris paribus, be the case. However, the only truly cross-cultural study of pathogen avoidance examined the effects of individual differences in disgust sensitivity

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across 30 different countries and found that the association between disgust sensitivity and social dominance orientation, a trait related to outgroup prejudice, was small (Tybur et al., 2016).

Third, most tests of the association between outgroup sentiments and pathogen avoidance are only indirect tests of the underlying theoretical notion that the behavioral immune system is adapted to avoid outgroups. Rather than looking at avoidance behavior specifically, studies examine potentially related constructs, such as prejudice or opposition to immigration. Similarly, rather than directly examining whether individuals motivated to avoid pathogens avoid outgroup members *more* than ingroup members, studies often merely assess the effects of such motivations on sentiments expressed toward outgroups (see Aarøe et al., 2016; although see Faulkner et al., 2004).

2. The current study: Aims and hypotheses

Given these concerns, the aim of the current study was to design a test that gets at the kernel of the argument that the behavioral immune system is designed to avoid outgroups. In addition, the aim was to design a study that allowed for a cross-cultural test, examining whether any findings replicated in a non-Western sample. To this end, we designed an experiment that focused on the most basic and most important output of the behavioral immune system: how comfortable participants were with physical contact with another individual (specifically, an adult male shown in a photo, referred to as the target). We manipulated whether the target individual had a cue of being a member of an ingroup or an outgroup, which allowed us to directly contrast comfort with both categories of individuals. Following the literature that has examined whether the behavioral immune system generates motivations to avoid outgroup individuals, we used one of the most salient group markers of today, ethnicity (or race), as a cue of ingroup or outgroup membership (see Kurzban et al.,

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2001). To examine the effect of pathogen-avoidance motivations directly, we relied on two approaches: first, we manipulated whether the target individual had a conspicuous cue of pathogenic infection (i.e., a severe facial rash); second, we included a measure of individual differences in motivations to avoid sources of pathogens (i.e., pathogen disgust sensitivity).

If the behavioral immune system involves design for motivating avoidance based on outgroup membership cues, then we should see that *comfort with contact is lower for outgroup targets than for ingroup targets* (H1). This should not only happen when the targets are without pathogen cues but also when they have conspicuous pathogen cues.[2] The claim is that the incentive to avoid outgroup individuals is the increased costs of being infected with especially harmful outgroup pathogens. Outgroup pathogens are proposed to be more dangerous than ingroup pathogens, as one would have less immunity to them. A functional response would therefore be to avoid seemingly contagious individuals, especially if they are outgroup members.

[2] It is unclear, a priori, whether and how the adaptation-for-groups account would predict the existence of an interaction between pathogen and group cues. Several interactions are possible, while only two would seem consistent with the adaptation-for-groups account. One possibility is that pathogen cues should increase the effect of group cues. If outgroup pathogens are more dangerous, individuals might be more wary about the presence of pathogen cues in outgroup (than ingroup) members. Another possibility is that the effect of pathogen cues is smaller for outgroup members. Arguably, the adaptation-for-groups account predicts that people should feel uncomfortable with contact with an outgroup individual who presents a pathogen cue, and it also predicts that people should feel uncomfortable with contact with an outgroup individual who presents no pathogen cue. In total, this implies that the effect of the pathogen cue is smaller for outgroup targets (change from uncomfortable to more uncomfortable) compared to the effect of the pathogen cue for ingroup targets (change from comfortable to uncomfortable). Other kinds of logically possible interactions would be inconsistent with the adaptation-for-groups account. For example, even if we observe that the effect of pathogen cues is larger for outgroup targets, it would be inconsistent with the adaptation-for-group account to the extent this interaction was driven by greater comfort with outgroup targets without a pathogen cue relative to ingroup targets. Similarly, if we observe that the effect of pathogen cues is larger for ingroup targets, it would still count has evidence against the adaptation-for-group account to the extent this reflected that ingroup targets with a pathogen cue evoke less comfort with contact than outgroup targets. Because of these competing possibilities, we do not form explicit interaction hypotheses but exploratively report the existence of interaction effects in the result sections.

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Furthermore, as noted in the introduction, individuals differ in the sensitivity of their behavioral immune system and in their motivations to avoid pathogens. If the behavioral immune system includes design for avoiding outgroup individuals, then such individual differences in the motivation to avoid pathogens should predict the avoidance of outgroup individuals without pathogen cues. If outgroup individuals without pathogen cues are perceived as a pathogen risk, then individuals who are highly motivated to avoid pathogens should be especially motivated to avoid outgroup individuals; that is, we should see *a negative association between pathogen disgust sensitivity and comfort with contact for outgroup targets without a pathogen cue* (H2). More specifically, for targets without a pathogen cue, the association between disgust sensitivity and comfort with contact should be more negative for outgroup targets than for ingroup targets. We test the adaptation-for-groups account by testing H1 and H2.

In contrast to these hypotheses, the *standard account* of the behavioral immune system holds that the system is designed to motivate the avoidance of correlates of pathogens (Curtis, Aunger, Rabie, 2004; Tybur et al., 2013; Tybur & Lieberman, 2016). This suggests that we should see comfort with contact being lower for targets with pathogen cues than for those without pathogen cues, regardless of group membership. Such an account is also consistent with negative correlations between pathogen disgust sensitivity and comfort with contact with other individuals, including individuals from outgroups. From a pathogen-avoidance perspective, other humans—including those from outgroups—are a primary vector of infectious disease (Aarøe et al., 2016; Mortensen, Becker, Ackerman, Neuberg, & Kenrick, 2010.) However, the simpler account predicts that individuals who are motivated to avoid pathogens should not feel especially motivated to avoid outgroup individuals. Rather, those motivated to avoid pathogens should feel especially motivated to avoid individuals who pose high pathogen risks, regardless of group membership. This account therefore implies

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that we should see a negative association between pathogen disgust sensitivity and comfort with contact, especially for targets with pathogen cues, independently of their group membership.

We tested these predictions with an experiment that we conducted with participants from the USA and India. A strong version of the adaptation-for-groups account implies that we should see support for the hypotheses regardless of cultural context. That is, if American individuals react negatively to seemingly foreign individuals (e.g., Indians) because of a dedicated adaptation to avoid other groups due to pathogens, we should see the mirror image of these effects among Indian individuals themselves. On a strong version of the adaptation-for-groups account, Indian individuals should react as negatively toward Americans as Americans do toward other Indians. By using the same methods in these two samples, any differences observed between the samples cannot be attributed to the materials used.

3. Method

We collected data from large samples in the USA and India via Amazon Mechanical Turk. We aimed to collect at least 400 participants per condition. N = 400 per condition gives power of .98 for observing a significant correlation for that condition, assuming that the true correlation has a magnitude of .20 (analysis with G*Power 3.1). Participants were paid a small fee for their participation (USA 0.70 USD; India 0.70 or 0.90 USD). In both samples, participants completed the same task.

Participants were presented with one of 16 photographs showing the face of an adult male. The presented adult male face was the target that the participant evaluated.[3] The target male was either White (with white skin color) or Indian (brown skin color), and either had no conspicuous pathogen cue (no modifications of the photograph) or a conspicuous pathogen

[3] The participant was shown the same photo on each screen in the survey that contained questions about the target.

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cue (the photos were modified to show a sore on the cheek). For each of these four kinds of targets, we included four different males (i.e. four different identities). In the analysis we collapsed across identities. We treat White targets as ingroup targets for the US sample and as outgroup targets for the Indian sample. Similarly, we treat Indian targets as outgroup targets for the US sample and as ingroup targets for the Indian sample. In both samples, the study thus involved a 2 (pathogen cue present vs. absent) × 2 (ingroup skin color vs. outgroup skin color) between-subjects design.

Participants indicated how comfortable they would be with shaking hands with the target ("How would you feel about shaking hands with the man in the photo?") and how comfortable they would be sitting next to this man on a bus ("How would you feel about this man sitting next to you on the bus?"). Both items were answered on an 11-point scale anchored *Very uncomfortable* (–5), *Neutral* (0), and *Very comfortable* (+5). Responses to these two questions were highly correlated (USA r = .89, India r = .83) and were averaged to form a measure of comfort with physical contact with the target (Spearman-Brown reliability USA = .94, India = .91).

To assess participants' stereotypes of the kind of males depicted in the photos, we asked for their first impressions of the target. Participants indicated for 14 traits how characteristic they were of the target male (ratings were made on a 7-point scale from *Not at all characteristic* (0) to *Very characteristic* (6). The 14 traits pertained to cleanliness (dirty, filthy, hygienic, clean), trustworthiness (likeable, trustworthy, unfriendly, aggressive), competence (capable, intelligent, ignorant, lazy), and wealth (rich, poor). The 14 traits were presented in random order.

Participants then completed two questions that served as manipulation checks. They indicated the health of the target ("Does the man look ill or healthy?") on an 11-point scale

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anchored *Very ill* (–5), *Not ill, not healthy* (0), and *Very healthy* (+5). They also indicated the similarity of the target to males in their local community ("Does this man look like the men in your local community?") on an 11-point scale from *Very different from the men in my community* (0) to *Very similar to the men in my community* (10).

Subsequently, participants completed the three-domain disgust scale (Tybur et al., 2009). This scale includes seven items measuring a key predictor variable, an individual difference measure of motivations to avoid pathogens: pathogen disgust sensitivity. Participants indicated how disgusting they find each item on a scale from *Not at all disgusting* (0) to *Extremely disgusting* (6). Example items include "Stepping on dog poop" and "Sitting next to someone who has red sores on their arm." The reliability of the scale was high in both samples: Cronbach's α USA = .86, India = .83.

Participants then completed several unrelated measures and the following demographics: age; sex; self-reported health on a 7-point scale from *very good* (1) to *very poor* (7); education on a 12-point scale from *no formal education* (0) to *completed graduate of professional school* (11); subjective social class on a 10-point scale from *bottom of ladder/society* (1) to *top of ladder/society* (10); and ethnicity (with nine answer options): *White* (1), *Black or African American* (2), *South Asian (Indian, Pakistani, etc.)* (3), *East Asian (Chinese, Japanese, Korean, etc.)* (4), *Latino or Hispanic* (5), *Middle Eastern or Arabic* (6), *Mixed* (7), *Other* (8), *Decline to answer* (9). Finally, because the survey examines responses to target males with light or dark skin and because responses to these targets might depend on a participant's own skin color, we asked participants to report their skin color with the following question: *This survey is about how people in different cultures perceive individuals with a particular skin color. Below is a figure with 10 hands, numbered from 1 to 10, with 1 representing albinism, or the total absence of color, and 10 representing the*

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darkest possible skin. Please select the number that best matches your skin color. Participants could proceed to the end of the survey without answering this question.

For the US sample, 1630 participants started the survey and 1615 (798 females, age M = 36.7, SD = 11.5) completed it. For the Indian sample, 2073 participants started the survey and 1969 (561 females, age M = 31.2, SD = 8.3) completed it. In each sample, each cell of the design included more than 400 participants who had completed the survey (ns: USA no cue/ingroup = 401, no cue/outgroup = 405, cue/ingroup = 404, cue/outgroup = 405; India no cue/ingroup = 495, no cue/outgroup = 489, cue/ingroup = 495, cue/outgroup = 490). We asked participants to indicate their ethnicity. In the US sample, most participants identified as White (78.7%) or African American (6.5%). Only a few participants identified as South Asian (1.8%). In the Indian sample, most participants identified as South Asian (92.7%) and only a few participants identified as White (1.7%).

4. Results

In the analysis below, dichotomous predictors were coded as 0 or 1 and continuous predictors were scaled to range from 0 to 1.

4.1. Manipulation checks

Responses to the questions about the similarity of the target to local males and the health of the target showed that the ingroup–outgroup and pathogen-cue manipulations worked as intended (see supplementary materials S1 and S2).

4.2. What was the effect of the manipulations on comfort with contact?

H1 stated that, according to the adaptation-for-groups account, comfort with contact is lower for outgroup targets than for ingroup targets. Figure 1 shows the medians for comfort with contact with the target across the experimental manipulations. The pattern resembles that observed for the health of the target (see Figure S2), suggesting that the pathogen cue

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manipulation had stronger effects on comfort with contact than the outgroup manipulation and that, against H1, the latter manipulation had little or no effect. A 2 (Group: ingroup vs. outgroup) × 2 (Pathogen cue: yes vs. no) × 2 (Country: USA vs. India) ANOVA supports this interpretation. The ANOVA revealed a significant main effect for Pathogen cue ($F(1, 3648) = 468.2$, $p < .001$, $r = .34$), but no significant main effect for Group ($F(1, 3648) = 0.17$, $p = .678$, $r = .007$). The main effect of Pathogen cue was qualified by a significant Group × Pathogen cue interaction ($F = 5.09$, $p = .024$), and a marginal Pathogen cue × Country interaction ($F = 2.80$, $p = .094$). Means for the Group × Pathogen cue interaction indicated that, on average, the negative effect of Pathogen cue was larger for outgroup targets ($M = –1.95$, $SE = 0.12$) than for ingroup targets ($M = –1.60$, $SE = 0.12$). Importantly, however, this interaction is not in a direction consistent with the adaptation-for-groups account. It is not driven by relatively low comfort with contact for outgroup targets with a pathogen cue, but rather by relatively high comfort with contact for outgroup targets without a pathogen cue (see Figure 1 and Table S3 in the supplementary materials). Means for the Pathogen cue × Country interaction showed that the negative effect of Pathogen cue is marginally larger in the US sample ($M = –1.93$, $SE = 0.12$) than the Indian sample ($M = –1.66$, $SE = 0.11$). (In addition, the ANOVA revealed a significant effect for Country, $F = 29.28$, $p < .001$. No other effects were significant, $ps > .29$.) In short, the analyses suggest that comfort with contact was strongly influenced by whether the target had a conspicuous pathogen cue, but not by whether the target was from an ingroup or outgroup. Hence, the analyses do not support H1 as derived from the adaptation-for-groups account of the behavioral immune system.

We examined whether these results were confounded by the ethnicity of the participants. In the US sample, some participants were not White and might not have perceived the targets as intended (i.e., Indian-American participants might have perceived the ingroup targets as outgroup individuals—and outgroup targets as ingroup individuals). We

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therefore did the same analysis while only including participants who had indicated the same ethnicity as the ingroup target (i.e., we included only American participants who had indicated White ethnicity, and only Indian participants who had indicated South Asian ethnicity). This analysis showed the same pattern, see supplementary materials S4.

4.3. How does pathogen disgust sensitivity predict comfort with contact?

According to the adaptation-for-groups account, H2 stated that we should find a negative association between pathogen disgust sensitivity and comfort with contact for outgroup targets without a pathogen cue. To test H2, we therefore examined correlations between individual differences in pathogen disgust and comfort with contact. For completeness, we report the correlations across all experimental manipulations. Consistent with the standard account of the behavioral immune system and the construct validity of both the pathogen disgust scale and the comfort with contact scale, pathogen disgust sensitivity and comfort with contact were associated for all targets with a pathogen cue (see Table 1). Turning to the focus of H2, for targets without a pathogen cue, we found in the US sample that pathogen disgust correlated negatively with comfort with contact for outgroup targets but not for ingroup targets (see Table 1). This is consistent with H2. However, the difference between these two correlations was not significant, $z = 1.53$, $p = .126$ (two sided). In the Indian sample, pathogen disgust sensitivity did not correlate for the targets without a pathogen cue (i.e. neither of the correlations was significantly different from zero, although these two correlations were not the same, $z = 2.12$, $p = .034$, two sided). In short, the pattern observed in the US sample provides tentative evidence consistent with the adaptation-for-groups account, whereas the pattern observed in the Indian sample is inconsistent with the adaptation-for-groups account as expressed in H2.

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Table 1: Zero-order correlations between pathogen disgust sensitivity and comfort with contact. In parentheses are correlations corrected for attenuation. When computing these correlations, only participants with the same ethnicity as the ingroup target were included (i.e., White participants in the US sample, South Asian participants in the Indian sample). * p < .05, ** p < .01, *** p < .001.

	USA		India	
	Pathogen cue	No pathogen cue	Pathogen cue	No pathogen cue
Ingroup targets	–.30*** (–.34) n = 310	–.06 (–.06) n = 337	–.14** (–.16) n = 461	–.08 (–.10) n = 462
Outgroup targets	–.29*** (–.33) n = 321	–.18** (–.20) n = 303	–.10* (–.12) n = 449	.06 (.07) n = 456

As usual, pathogen disgust sensitivity correlated substantially with sexual disgust sensitivity (USA r = .51, India r = .59) and moral disgust sensitivity (USA r = .40, India r = .67). Therefore, to confirm the robustness of the associations shown in Table 1, we computed a regression model that controlled for sexual and moral disgust sensitivity and demographic variables. We regressed comfort with contact on pathogen disgust sensitivity, outgroup, pathogen cue, and country (including all interactions between these four terms), and included variables to control for the participants' sexual disgust sensitivity, moral disgust sensitivity, age, sex, self-reported health, education, social class, and skin color (including the interaction of skin color with outgroup and including the interaction of country with each other variable). To test H2, we then computed marginal slopes (i.e., simple slopes) for pathogen disgust predicting comfort with contact (see Figure 2). To test for differences between slopes we examined interaction effects (following standard procedures that involve coding of dummy variables; see West, Aiken, & Krull, 1996).

In the US sample, for ingroup targets without a pathogen cue, the association between pathogen disgust sensitivity and comfort with contact was negative but marginal (b = –1.28, SE = 0.69, 95% CI for b = –2.63, 0.07). The association for outgroup targets was negative

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and significant (b = –2.52, SE = 0.65, 95% CI for b = –3.79, –1.24). Consistent with the zero-order correlations, however, these slopes were not significantly different (Pathogen disgust × Outgroup b = –1.24, SE = 0.90, t(3536) = –1.37, p = .170). (Including only participants with the same ethnicity as the ingroup target resulted in a similar pattern, see supplementary materials S5.)

In the Indian sample, for ingroup targets without a pathogen cue, the association between pathogen disgust sensitivity and comfort with contact was negative and significant, (b = –2.43, SE = 0.61, 95% CI for b = –3.61, –1.24). However, the association for outgroup targets was not different from zero (b = –0.52, SE = 0.64, 95% CI for b = –1.78, 0.74). The interaction term (in a model that included a dummy variable that coded for USA rather than for India) showed that these slopes were significantly different (Pathogen disgust × Outgroup b = 1.91, SE = 0.79, t(3536) = 2.43, p = .015).

The regression analysis also revealed that the slope for ingroup targets without pathogen cues did not differ across the American and Indian participants, Pathogen disgust × Country (b = –1.14, SE = 0.91, t(3536) = –1.25, p = .210). The interaction term (computed by including a dummy variable coding for ingroup rather than for outgroup) suggests that the slope for outgroup targets without pathogen cues was different across the American and Indian participants, Pathogen disgust × Country (b = 2.00, SE = 0.91, t(3536) = 2.19, p = .029).

In summary, even when controlling for several other individual difference variables, the association between pathogen disgust sensitivity and comfort with contact for targets

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without pathogen cues is consistent with the adaptation-for-groups account in the US sample but not in the Indian sample.[4]

4.4. Additional analyses

In the US sample, pathogen disgust sensitivity predicted discomfort with contact with outgroup targets without a pathogen cue. But this was not the case in the Indian sample. It should be noted that this particular correlation in the US sample is the only result thus far that is consistent with the adaptation-for-groups account (although this correlation does not significantly differ between ingroup and outgroup targets). Still, consistent with existing studies, it seems that we are able to reproduce the association between pathogen disgust and a correlate of outgroup prejudice, but we find that this association does not generalize to the Indian sample. As almost all previous studies on prejudice and pathogen disgust have been collected in Western (often Anglo-American) countries, this invites the possibility that this association is the expression of culturally contingent dynamics in the West rather than the expression of universal psychological processes as hypothesized by the adaptation-for-groups account. Before delving deeper into this argument, we performed a number of additional analyses to check whether the Indian findings were inconsistent with the adaptation-for-groups account due to potential confounds.

First, we examined whether the inconsistent slopes for outgroup targets without pathogen cues (negative in the USA, flat in India) could be explained by differences in the perceived familiarity of the outgroup target (see supplementary materials S6). This analysis suggests that individual differences in perceived familiarity did not influence the association between pathogen disgust sensitivity and comfort with contact. Furthermore, among Indian

[4] For targets with a pathogen cue, the associations reported in Table 1 were robust to controlling for these individual difference variables. US sample [95% CI]: ingroup targets b = –3.53 [–4.76, –2.30], outgroup targets b = –4.45 [–5.74, –3.15]. Indian sample: ingroup targets b = –3.20 [–4.37, –2.02], outgroup targets b = –2.57 [–3.81, –1.34].

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participants who perceived the target as unfamiliar, pathogen disgust did not significantly predict comfort with contact. In sum, controlling for the familiarity of the targets did not reveal support for the adaptation-for-groups account in the Indian sample.

Second, we examined whether the inconsistent slopes for outgroup targets without pathogen cues could be explained by Indians, on average, having more positive stereotypes about the outgroup targets (see supplementary materials S7). Against the existence of this confound, however, the analysis suggests that controlling for outgroup stereotypes did not reveal a negative association between pathogen disgust sensitivity and comfort with contact in the Indian sample. We also found that individual differences in outgroup stereotypes did not influence the association between pathogen disgust sensitivity and comfort with contact. In short, controlling for outgroup stereotypes did not yield results consistent with the adaptation-for-groups account.

Overall, these additional analyses suggest that the differences between the US and Indian samples are not due to some obvious confound and, hence, that the association between pathogen disgust sensitivity and comfort with contact with outgroup targets without a pathogen cue emerges from processes that are culturally specific for US (or Western) culture. To probe these processes, we decomposed the association in the US sample and, specifically, examined the types of beliefs that underlie it as measured by the stereotype scales. For comparison, we did so for both the outgroup target with and without a pathogen cue. Recall that we had available measures of stereotypical beliefs about the targets' dirtiness, trustworthiness, competence, and wealth. Table 2 displays the contribution of each of these beliefs to the association for the two outgroup targets in the US sample.

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Table 2. Decomposition of the effect of pathogen disgust sensitivity on comfort with contact with outgroup targets (US sample only).

Pathogen cue in target	Effect of pathogen disgust	Contribution of stereotypical beliefs			
		Dirty	Trustworthy	Competent	Rich
No	Uncontrolled: b = –1.85** Controlled: b = –.31 Difference: b = –1.54**	21% b = –0.39 p = .09	59% b = –1.08 p = .001	4% b = –0.08 p = .28	–1% b = 0.01 p = .40
Yes	Uncontrolled: b = –4.56*** Controlled: b = –1.86* Difference: b = –2.70***	31% b = –1.43 p < .001	22% b = –1.01 p = .002	1% b = –0.04 p = .37	5% b = –0.23 p = .14

Notes. The decomposition was performed with the method developed in Kohler, Karlson & Holm (2011). The column “Pathogen cue in target” specifies whether the outgroup target was presented without (No) or with a pathogen cue (Yes). “Effect of pathogen disgust” specifies the effect of pathogen disgust before controlling for stereotypical beliefs (Uncontrolled), after control (Controlled), and the difference in effects before and after. The columns under “Contribution of stereotypical beliefs” specify how large a percent of the uncontrolled effect is attributable to each of the stereotypical beliefs. All models are controlled for participants’ sexual disgust sensitivity, moral disgust sensitivity, age, sex, self-reported health, education, social class, and skin color; b coefficients are unstandardized OLS regression coefficients. Note that the method cannot determine whether the reduction in the effect of pathogen disgust reflects spurious or indirect effects. To facilitate the interpretation of the table, we also computed standardized regression coefficients for predicting the stereotypes from pathogen disgust sensitivity. For the outgroup target without pathogen cues, these are: $\beta_{dirty} = 0.10$, $p = 0.07$; $\beta_{trustworthy} = –0.22$, $p < .001$; $\beta_{competent} = –0.11$, $p < .05$; $\beta_{rich} = –0.22$, $p < .001$. For the outgroup target with pathogen cues, the coefficients are: $\beta_{dirty} = 0.34$, $p < .001$; $\beta_{trustworthy} = –0.24$, $p < .001$; $\beta_{competent} = –0.13$, $p = .03$; $\beta_{rich} = –0.22$, $p = .07$.

The first important insight is that these beliefs fully account for the effect of pathogen disgust on comfort with outgroup targets without a pathogen cue, whereas this is not the case for outgroup targets with a pathogen cue. This suggests that the former association is facilitated by a co-variation between pathogen disgust sensitivity and particular sets of explicit beliefs about outgroups. Furthermore, the decomposition suggests that the association is primarily produced by a co-variation between beliefs about the trustworthiness of the target and pathogen disgust sensitivity. Beliefs about outgroups as dirty (i.e., beliefs that are directly pathogen-related) have a smaller but marginally significant contribution. In contrast, for the

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association for outgroup targets with a pathogen cue, the largest contributor is the belief that the target is dirty; beliefs about trustworthiness play a secondary (but still significant) role.

These differences in the role of explicit beliefs for the association between pathogen disgust sensitivity and comfort with contract for outgroup targets with and without a pathogen cue seem at odds with a strong version of the adaptation-for-groups account. In particular, it seems inconsistent with the adaptation-for-groups account that beliefs about trustworthiness rather than cleanliness played a large role, specifically for targets without a pathogen cue. In this respect, it is worth noting that previous research has shown that perceptions of trustworthiness strongly influence tendencies to approach or avoid others (e.g., Fiske, Cuddy, & Glick, 2007) and that pathogen disgust sensitivity specifically is associated with a lack of trust in others (Aarøe et al., 2016). This invites the possibility that people high in disgust sensitivity are particularly susceptible to rhetoric that portraits racial outgroups as untrustworthy, that individuals in the US are particularly prone to be exposed to such rhetoric (see Gilens, 1999), and, hence, that the association between outgroup prejudice and disgust sensitivity emerges as a culturally contingent by-product of this dynamic.

5. Discussion

The current experiment was designed so that it could provide direct and strong support for the adaptation-for-groups account. However, the findings do not support the notion that antipathy toward outgroup individuals is an adaptation of the behavioral immune system. Overall, the findings provide strong support for a simpler perspective: that the behavioral immune system motivates the avoidance of individuals displaying correlates of infectious disease. Both among participants from the USA and India, we observed strong experimental effects consistent with this prediction. In both samples, targets with pathogen cues evoked more discomfort. In contrast, outgroup targets did not consistently evoke more

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discomfort than ingroup targets. Finally, pathogen disgust sensitivity predicted discomfort toward outgroup targets without pathogen cues *only* in the American sample, but this correlation was not significantly different from the correlation for ingroup targets and was associated with explicit beliefs about, in particular, the trustworthiness of the target. Additional analyses showed that the lack of support for the adaptation-for-groups account from the Indian sample was not explained by the Indian participants' perceptions and stereotypes about the White outgroup males. Consistent with the wording of the pathogen disgust scale, it consistently predicted discomfort with contact for targets with a pathogen cue across all manipulations and countries.

5.1. Limitations

These findings should be interpreted while taking into account several limitations of the current research. First, the findings should primarily be seen as providing evidence against the adaptation-for-groups account. Some of the findings provide support for the standard account (i.e., the effects observed for the pathogen cue manipulation), but other findings—the negative correlations between pathogen disgust sensitivity and comfort with contact for targets with a pathogen cue—should not be counted as support for the standard account. Because of the theoretical solidity of the standard account, it forms the basis of the measurement of pathogen disgust sensitivity. Specifically, some of the items in the scale more-or-less ask how comfortable the participant is with contact with a person with pathogen cues. Consequently, the correlations between pathogen disgust sensitivity and discomfort with contact for targets with a pathogen cue should generally be taken as testifying to the construct validity of the involved measures.[5] Second, the study was performed online and likely included only participants from the USA and India who had an extensive history of

[5] Note that this limitation is less relevant for the decomposition in Table 2, as the explicit beliefs included in this analysis are not part of the pathogen disgust sensitivity measure.

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modern information technology use. Consequently, while care was taken to provide a cross-cultural test, these participant groups were most likely less culturally different than could have been the case (and both groups certainly lived in an a-typical environment compared to the recurrent conditions over human evolutionary history). Third, this was an online study relying on self-reporting. It did not include measures of overt behavior. We assumed that participants were able to generate valid feelings about physical contact with an unknown individual based on a facial photograph and would provide honest answers. Indeed, the relatively high comfort with contact for outgroup targets without a pathogen cue (section 4.2) might reflect task demands (i.e., that participants reported higher levels of comfort to not appear biased against outgroups, either because participants did not want to reveal such antipathy or because they assumed that they were supposed to show sympathy toward these targets). Ideally, the current study would be replicated involving real social interactions and behavioral measures of avoidance of physical contact. Fourth, we used skin color to manipulate ingroup vs. outgroup membership. Although this is in line with research and theory about the behavioral immune system and intergroup relations (e.g., Faulkner et al., 2004; Kurzban et al., 2001), a different ingroup vs. outgroup manipulation might yield different observations.

5.2. Explaining the association between outgroup prejudice and pathogen-avoidance motivations

If the behavioral immune system is not designed to process cues of group membership but rather cues of manifest infection, this suggests that we need to interpret any link between outgroup prejudice and pathogen-avoidance motivations as *byproducts* of a system adapted for other purposes (see also Aarøe et al., 2016; Fessler et al., 2015; Petersen, 2017). That is, antipathy toward outgroup individuals produced by the behavioral immune system is due to

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some of the features of outgroup individuals falling within the actual domain (not the proper domain) of some perceptual mechanism of the behavioral immune system.

First, like other threat-detection mechanisms, the behavioral immune system is possibly designed to make false-positive errors (perceiving pathogens where they are absent) rather than false-negative errors (failing to perceive pathogens where present; Haselton & Nettle, 2006; Nesse, 2005; Schaller & Park, 2011). In other words, the behavioral immune system is hyperactive, working in a "better safe than sorry" manner, and might therefore generate antipathy toward people who look atypical or unfamiliar (e.g., people with obesity, physical disabilities, or with large facial birthmarks; see Park, Faulkner, & Schaller, 2003; Park, Schaller, & Crandall, 2007; Ryan, Oaten, Stevenson, & Case, 2012). Because outgroup members often deviate from the normal phenotype within a particular group, outgroup prejudice could emerge as a result (Petersen, 2017). This would not be because the behavioral immune system is designed to avoid outgroups in particular but rather because it is designed to avoid atypical humans in general. Consistent with this, Petersen (2017) found that people implicitly put healthy individuals with a different skin color into the same mental category as manifestly infected ingroup individuals. Such error-management processes could be further facilitated by the dynamics described below.

Second, people possibly respond to pathogen threats by way of greater ingroup conformity and outgroup prejudice might be a derived effect of this. Greater ingroup conformity could both reflect that a number of cultural norms are specifically designed to guard against infection (e.g., taboos about food and sex; see Fessler & Navarrete, 2003) and that social support is required for health care (Jensen & Petersen, 2017). Consistent with this, cross-cultural evidence suggests that individuals who are more disgust sensitive are more supportive of traditionalism (Tybur et al., 2016). Such processes might entail expressions of dislike of outgroups to signal ingroup loyalty (Navarrete & Fessler, 2005) or because the

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outgroups are not familiar with the ingroup's cultural taboos. One might count the mechanisms producing such ingroup conformity in response to pathogen threats as parts of the behavioral immune system. Even then, however, the system would not reflect that outgroups had more dangerous pathogens but, instead, the need for social support and culturally coordinated hygiene norms.

Third, the behavioral immune system might generate antipathy toward individuals from social categories that are strongly associated with infectious disease. Fessler et al. (2015) argue that the behavioral immune system may include features designed for learning and transmitting information that is relevant for avoiding pathogens. Indeed, it would be functional to have a capacity for learning from others about which individuals are contagious before you interact with them yourself. Such capacities might result in heightened attention to and memory for information (including rumors with little evidential basis) linking a particular group (e.g., Tunesians) to contagious disease. Around the world, political propaganda has often portrayed outgroups as vectors of diseases (most notoriously illustrated with the linking of vermin and Jewish people in Nazi propaganda), and a number of segregation-oriented policies such as Apartheid in South African and the so-called Jim Crow laws in the US have helped sustain such portrayals by carefully regulating physical contact between the in- and outgroup. The theoretical arguments by Fessler et al. (2015) suggest that people, disgust-sensitive people in particular, will be highly susceptible to such political messages. Here, it is also important to note that disgust-sensitive people generally tend to be wary toward strangers (Aarøe et al., 2016); hence, the susceptibility of disgust-sensitive individuals might extend beyond disease information to more general types of negative information. In this perspective, outgroup prejudice might emerge as a byproduct of the interaction between the behavioral immune system and culturally-contingent attempts by political entrepreneurs to stigmatize particular outgroups. Three observations in the present manuscript appear

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consistent with this notion. First, as noted in the introduction, studies identifying a link between pathogen-avoidance motivations and outgroup prejudice have failed to take such confounds into account and can, at least in principle, be explained in this manner. Second, we only observed an association between disgust sensitivity and healthy outgroup targets in one culture, the United States, which has been known for the stigmatization of outgroups on the basis of skin color. Third, this association was fully produced by explicit beliefs about the targets' trustworthiness and cleanliness rather than the type of automatic, intuitive processes often attributed to the behavioral immune system.

In closing, it should be noted that these byproduct accounts do not entail that *all* motivations to avoid outgroup individuals are byproducts. The psychological mechanisms that evolved for navigating intergroup contexts very likely include adaptations for avoiding outgroup individuals. The byproduct accounts described here merely claim that these adaptations are not components (i.e. evolved design features) of the behavioral immune system. This claim does also not imply that the behavioral immune system never produces motivations to avoid outgroup individuals. As all adaptations, the system may generate behaviors for which it did not evolve (due to the actual domain being a larger set of stimuli than the proper domain or because the system is calibrated to make false-positive errors rather than false-negative errors). The byproduct account described here just claims that the behavioral immune system includes evolved design for avoiding sources of pathogens but does not include design for avoiding outgroup individuals in particular.

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Data Availability

The data associated with this research are available via the Open Science Framework at https://doi.org/10.17605/OSF.IO/MD7NB

References

Aarøe, L., Osmundsen, M., & Petersen, M. B. (2016). Distrust as a disease avoidance strategy: Individual differences in disgust sensitivity regulate generalized social trust. *Frontiers in Psychology, 7,* 1038. doi: 10.3389/fpsyg.2016.01038

Aarøe, L., Petersen, M. B., & Arceneaux, K. (2017). The behavioral immune system shapes political intuitions: Why and how individual differences in disgust sensitivity underlie opposition to immigration. *American Political Science Review, 111,* 277–294. doi:10.1017/s0003055416000770

Barrett, H. C., & Kurzban, R. (2006). Modularity in cognition: Framing the debate. *Psychological Review, 113*(3), 628–647. doi:10.1037/0033-295x.113.3.628

Curtis, V., Aunger, R., & Rabie, T. (2004). Evidence that disgust evolved to protect from risk of disease. *Proceedings of the Royal Society of London B: Biological Sciences, 271*(Suppl 4), S131–S133. doi:10.1098/rsbl.2003.0144

Curtis, V., de Barra, M., & Aunger, R. (2011). Disgust as an adaptive system for disease avoidance. *Philosophical Transactions of the Royal Society B, 366*, 389–401. doi:10.1098/rstb.2011.0002

de Barra, M., & Curtis, V. (2012). Are the pathogens of out-groups really more dangerous? *Behavioral and Brain Sciences, 35*, 85–86. doi: 10.1017/S0140525X11000975

ACCEPTED MANUSCRIPT

Faulkner, J., Schaller, M., Park, J. H., & Duncan, L. A. (2004). Evolved disease-avoidance mechanisms and contemporary xenophobic attitudes. *Group Processes & Intergroup Relations, 7*(4), 333–353. doi:10.1177/1368430204046142

Fessler, D. M. T., & Navarrete, C. D. (2003). Meat is good to taboo: Dietary proscriptions as a product of the interaction of psychological mechanisms and social processes. *Journal of Cognition and Culture, 3*(1), 1–40. doi:10.1163/156853703321598563

Fessler, D. M. T., Clark, J. C., & Clint, E. K. (2015). Evolutionary psychology and evolutionary anthropology. In D. M. Buss (Ed.), *The handbook of evolutionary psychology,* 2nd ed., Vol. 2., (pp. 1029–1046). Hoboken, NJ: Wiley.

Fincher, C. L., & Thornhill, R. (2012). Parasite-stress promotes in-group assortative sociality: The cases of strong family ties and heightened religiosity. *Behavioral and Brain Sciences, 35*, 61–79. doi:10.1017/s0140525x11000021

Fiske, S. T., Cuddy, A. J. C., & Glick, P. (2007). Universal dimensions of social cognition: Warmth, then competence. *Trends in Cognitive Science, 11*, 77–83. doi:10.1016/j.tics.2006.11.005

Gilens, M. (1999). *Why Americans hate welfare: Race, media, and the politics of antipoverty policy*. Chicago: University of Chicago Press.

Hamamura, T., & Park, J. H. (2010). Regional differences in pathogen prevalence and defensive reactions to the “swine flu” outbreak among East Asians and Westerners. *Evolutionary Psychology, 8*(3), 147470491000800. doi:10.1177/147470491000800315

Haselton, M. G., & Nettle, D. (2006). The paranoid optimist: An integrative evolutionary model of cognitive biases. *Personality and Social Psychology Review, 10*, 47–66. doi:10.1207/s15327957pspr1001_3

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). Most people are not WEIRD. *Nature, 466*(7302), 29–29. doi:10.1038/466029a

ACCEPTED MANUSCRIPT

ACCEPTED MANUSCRIPT

Huang, J. Y., Sedlovskaya, A., Ackerman, J. M., & Bargh, J. A. (2011). Immunizing against prejudice: Effects of disease protection on attitudes toward out-groups. *Psychological Science, 22*, 1550–1556. doi:10.1177/0956797611417261

Inbar, Y., Pizarro, D., Knobe, J., & Bloom, P. (2009). Disgust sensitivity predicts intuitive disapproval of gays. *Emotion, 9*, 435–439. doi:10.1037/a0015960

Jensen, C., & Petersen, M. B. (2017). The deservingness heuristic and the politics of health care. *American Journal of Political Science, 61*, 68–83. doi:10.1111/ajps.12251

Kohler, U., Karlson, K. B., & Holm, A. (2011). Comparing coefficients of nested nonlinear probability models using khb. *Stata Journal*, *11*(3), 420–438.

Kurzban, R., & Leary, M. R. (2001). Evolutionary origins of stigmatization: The functions of social exclusion. *Psychological Bulletin, 127*, 187–208. doi:10.1037//0033-2909.127.2.187

Kurzban, R., Tooby, J., & Cosmides, L. (2001). Can race be erased? Coalitional computation and social categorization. *Proceedings of the National Academy of Sciences, 98*, 15387–15392. doi:10.1073/pnas.251541498

Miller, S. L., & Maner, J. K. (2012). Overperceiving disease cues: The basic cognition of the behavioral immune system. *Journal of Personality and Social Psychology, 102*, 1198–1213. doi:10.1037/a0027198

Mortensen, C. R., Becker, D. V., Ackerman, J. M., Neuberg, S. L., & Kenrick, D. T. (2010). Infection breeds reticence: The effects of disease salience on self-perceptions of personality and behavioral avoidance tendencies. *Psychological Science, 21*, 440–447. doi:10.1177/0956797610361706

Murray, D. R., & Schaller, M. (2016). The behavioral immune system: Implications for social cognition, social interaction, and social influence. *Advances in Experimental Social Psychology, 53*, 75–129.

ACCEPTED MANUSCRIPT

ACCEPTED MANUSCRIPT

Navarrete, C. D., & Fessler, D. M. T. (2005) Normative bias and adaptive challenges: A relational approach to coalitional psychology and a critique of Terror Management Theory. *Evolutionary Psychology, 3*, 297–325. doi:10.1177/147470490500300121

Navarrete, C. D., & Fessler, D. M. T. (2006). Disease avoidance and ethnocentrism: The effects of disease vulnerability and disgust sensitivity on intergroup attitudes. *Evolution and Human Behavior*, *27*(4), 270–282. doi:10.1016/j.evolhumbehav.2005.12.001

Navarrete, C. D., Fessler, D. M. T., & Eng, S. J. (2007). Elevated ethnocentrism in the first trimester of pregnancy. *Evolution and Human Behavior*, *28*, 60–65. doi:10.1016/j.evolhumbehav.2006.06.002

Nesse, R. M. (2005). Natural selection and the regulation of defenses: A signal detection analysis of the smoke detector principle. *Evolution and Human Behavior*, *26*, 88–105. doi:10.1016/j.evolhumbehav.2004.08.002

Oaten, M., Stevenson, R. J., & Case, T. I. (2009). Disgust as a disease-avoidance mechanism. *Psychological Bulletin, 135*, 303–321. doi:10.1037/a0014823

Oaten, M., Stevenson, R. J., & Case, T. I. (2011). Disease avoidance as a functional basis for stigmatization. *Philosophical Transactions of the Royal Society, B: Biological Sciences, 366,* 3433–3452. doi:10.1098/rstb.2011.0095

Park, J. H., Faulkner, J., & Schaller, M. (2003). Evolved disease-avoidance processes and contemporary anti-social behavior: Prejudicial attitudes and avoidance of people with physical disabilities. *Journal of Nonverbal Behavior, 27*, 65–87. doi:10.1023/A:1023910408854

Park, J. H., Schaller, M., & Crandall, C. S. (2007). Pathogen-avoidance mechanisms and the stigmatization of obese people. *Evolution and Human Behavior, 28,* 410–414. doi: 10.1016/j.evolhumbehav.2007.05.008

ACCEPTED MANUSCRIPT

Petersen, M. B. (2017). Healthy outgroup members are psychologically represented as infected ingroup members. *Psychological Science*. https://doi.org/10.1177/0956797617728270

Ryan, S., Oaten, M., Stevenson, R. J., & Case, T. I. (2012). Facial disfigurement is treated like an infectious disease. *Evolution and Human Behavior*, *33*, 639–646. doi:10.1016/j.evolhumbehav.2012.04.001

Schaller, M. (2006). Parasites, behavioral defenses, and the social psychological mechanisms through which cultures are evoked. *Psychological Inquiry, 17*, 96–101.

Schaller, M., & Park, J. H. (2011). The behavioral immune system (and why it matters). *Current Directions in Psychological Science*, *20*, 99–103. doi: 10.1177/0963721411402596

Sperber, D. (1994). The modularity of thought and the epidemiology of representations. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 39–67). Cambridge, UK: Cambridge University Press.

Thornhill, R. & Fincher, C. L. (2014). *The parasite-stress theory of values and sociality: Infectious disease, history and values worldwide.* Cham (Switzerland) and New York: Springer International.

Tybur, J. M., Inbar, Y., Aarøe, L., Barclay, P., Barlow, F. K., de Barra, M. … Žeželj, I. (2016). Parasite stress and pathogen avoidance relate to distinct dimensions of political ideology across 30 nations. *Proceedings of the National Academy of Sciences, 113*, 12408–12413. doi:10.1073/pnas.1607398113

Tybur, J. M., & Lieberman, D. (2016). Human pathogen avoidance adaptations. *Current Opinion in Psychology*, *7*, 6–11. doi:10.1016/j.copsyc.2015.06.005

ACCEPTED MANUSCRIPT

Tybur, J. M., Lieberman, D., & Griskevicius, V. (2009). Microbes, mating, and morality: Individual differences in three functional domains of disgust. *Journal of Personality and Social Psychology, 97*, 103–122. doi:10.1037/a0015474

Tybur, J. M., Lieberman, D., Kurzban, R., & DeScioli, P. (2013). Disgust: Evolved function and structure. *Psychological Review, 120*, 65–84. doi:10.1037/a0030778

Tybur, J. M., Merriman, L. A., Hooper, A. E. C., McDonald, M. M., & Navarrete, C. D. (2010). Extending the behavioral immune system to political psychology: Are political conservatism and disgust sensitivity really related? *Evolutionary Psychology, 8*, 599–616, doi: 10.1177/147470491000800406

Van Leeuwen, F., Hunt, D. F., & Park, J. H. (2015). Is obesity stigma based on perceptions of appearance or character? Theory, evidence, and directions for further study. *Evolutionary Psychology, 13*, 1474704915600565. doi:10.1177/1474704915600565

VanderWaal, K. L., Obanda, V., Omondi, G. P., McCowan, B., Wang, H., Fushing, H., & Isbell, L. A. (2016). The “strength of weak ties” and helminth parasitism in giraffe social networks. *Behavioral Ecology, 27*, 1190–1197. doi: 10.1093/beheco/arw035.

West, S. G., Aiken, L. S., & Krull, J. L. (1996). Experimental personality designs: Analyzing categorical by continuous variable interactions. *Journal of Personality, 64*, 1–48. doi: 10.1111/j.1467-6494.1996.tb00813.x

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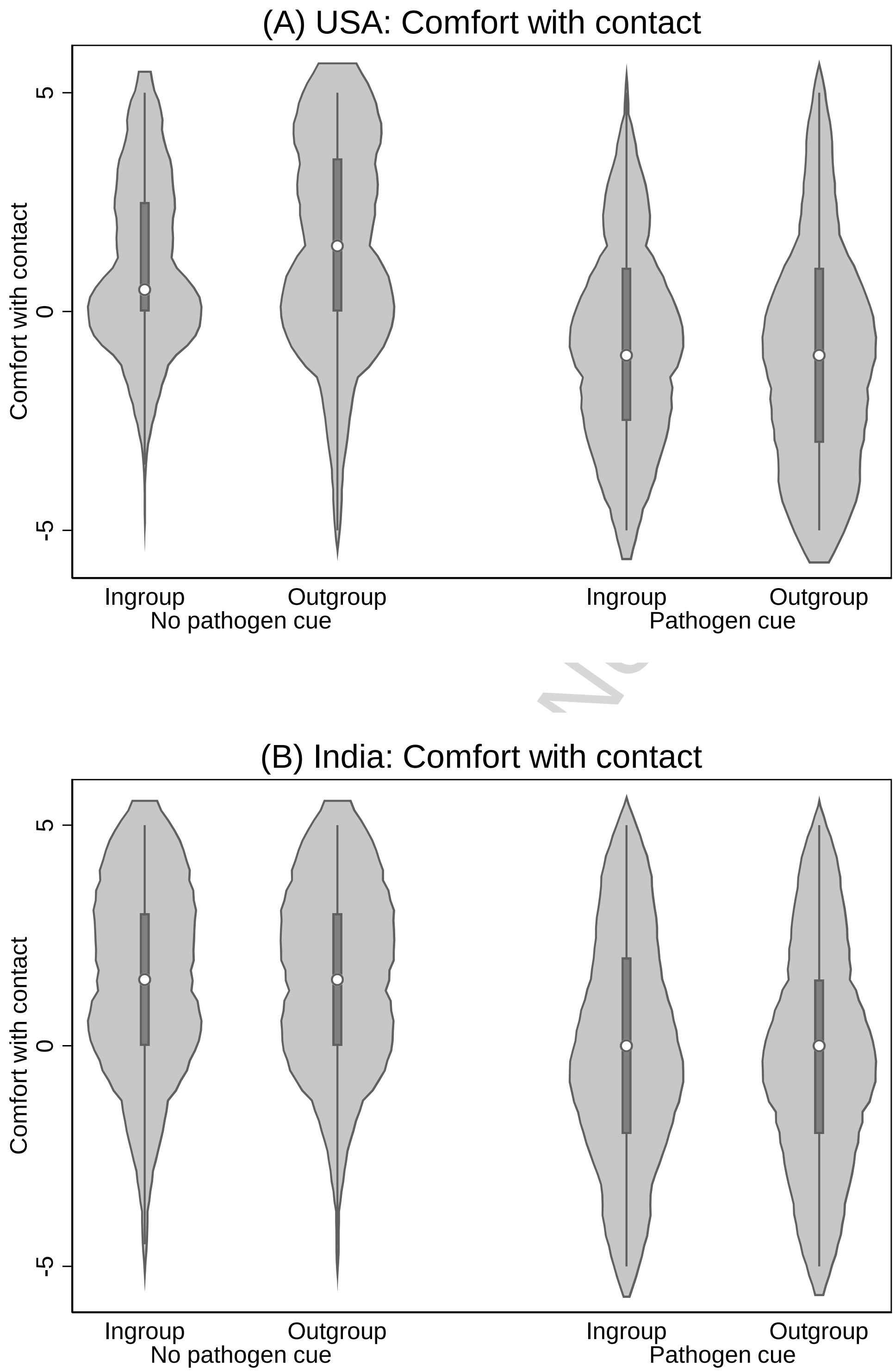

Figure 1. Violin plots for comfort with contact across the four conditions for the US sample (A) and the Indian sample (B). The vertical axis shows comfort with contact with the target. Comfort with contact is the average response for two items about shaking hands and sitting in a bus (see text for full items). Both items were measured on an 11-point scale anchored *Very uncomfortable* (–5), *Neutral* (0), and *Very comfortable* (+5). The white dot shows the median, the grey bar shows the interquartile range, and the vertical line extends to the highest and lowest values. The violin shows the estimated kernel density.

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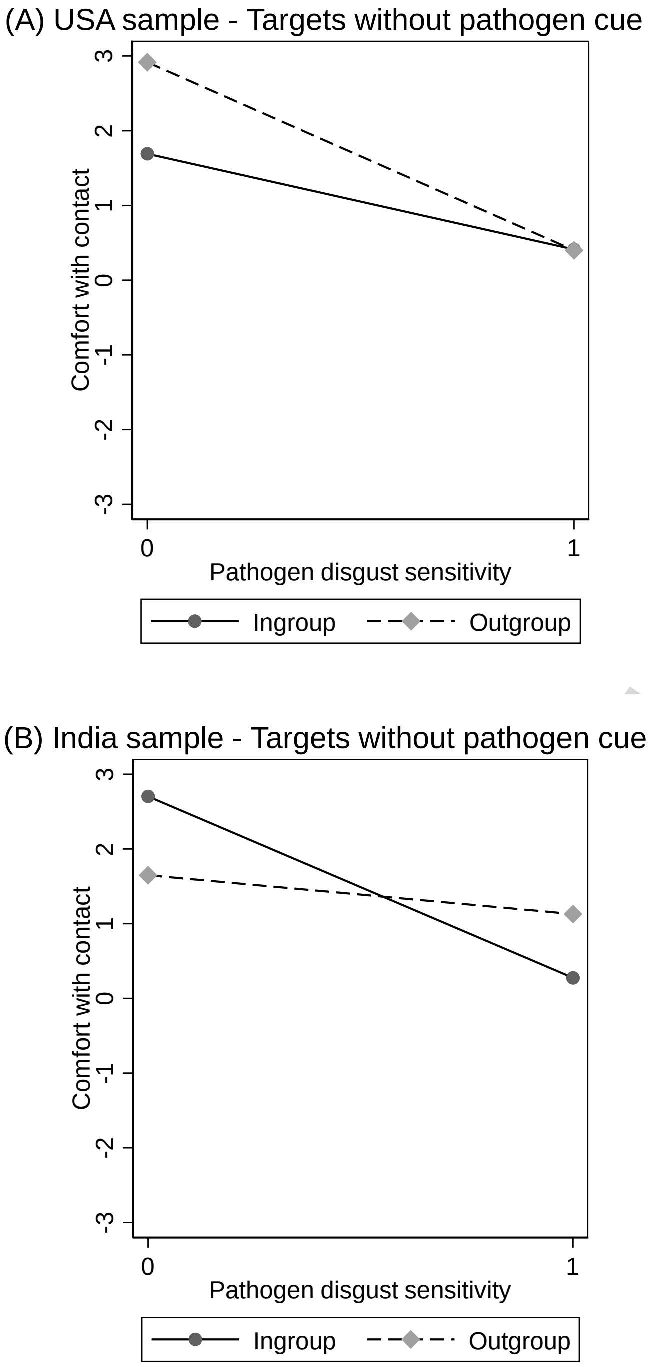

Figure 2. Predicted values for comfort with contact by pathogen disgust sensitivity for targets without a pathogen cue. Graph A shows the slopes for the US sample, graph B shows the slopes for the Indian sample. The solid lines show the slopes for ingroup targets, the dashed lines for outgroup targets.