Do Experimental Manipulations of Pathogen Avoidance Motivations Influence Conformity?

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Abstract

By conforming to ingroup norms, individuals coordinate with other group members, preserve cohesion, and avoid costs of exclusion. Experimental studies have shown that increased concerns about infectious disease increases conformity. However, coordination with other group members has myriad benefits, most of which exist independent of pathogenic infection. Accordingly, a strong causal effect of pathogen avoidance motivations on conformity appears unlikely. In line with this theoretical concern, results from five studies ($N = 1943$) showed no support for the hypothesis that experimentally increasing pathogen avoidance motivations influences conformity. The findings are inconsistent with the notion that associations between the prevalence of infectious disease and conformity observed at the cross-cultural level result from a fast-acting psychological mechanism that regulates conformity as a function of pathogen avoidance motivations.

Keywords: pathogen avoidance, disgust, behavioral immune system, conformity, norms

Do Experimental Manipulations of Pathogen Avoidance Motivations Influence Conformity?

Infectious disease influences many aspects of human psychology and behavior. Over the last decade, researchers have found support for the idea that humans have a behavioral immune system, a collection of psychological mechanisms that enables individuals to detect pathogens and motivate behaviors that prevent these pathogens from entering the body (Murray & Schaller, 2016; Tybur & Lieberman, 2016). Ongoing research investigates how the behavioral immune system works, what information it takes as input, what cognitions, emotions, and behaviors it produces as output, and how these outputs influence broader social and cultural phenomena. One key finding is that the emotion of disgust is evoked by stimuli associated with pathogens (e.g., feces, rotten food, bodily fluids) and motivates physical avoidance of objects and people associated with such stimuli (e.g., Oaten et al., 2011, Tybur et al., 2013; van Leeuwen & Petersen, 2018). The focus of the current study is on a broader social phenomenon arguably related to pathogen avoidance: conformity (Murray & Schaller, 2012; Murray et al., 2011).

Explaining the Relation Between Pathogen Avoidance and Conformity

People often conform to norms. Research has pointed to two central motivations for conforming to perceived norms: accuracy and affiliation. The first motivation operates when people are uncertain about what to do (e.g., because they have insufficient or ambiguous information) and results in *informational* conformity, while the second motivation operates when people want to fit in or be accepted by their group members and results in *normative* conformity (Cialdini & Goldstein, 2004; Griskevicius et al., 2006; Henrich & McElreath, 2007).

But why would the mind contain a mechanism that increases conformity when perceiving infection risks? Previous work has developed two candidate explanations¹. We label these the *social support* account and the *protective norms* account.

The social support account is based on an adaptationist analysis of normative attitudes (i.e., endorsement of ingroup attitudes and worldviews; Navarrete & Fessler, 2005; 2006; Navarrete et al., 2004). The social support account makes three assumptions. The first assumption is that there are adaptive challenges that can be effectively addressed with social support and adaptive challenges that cannot be addressed with social support. The second assumption is that by expressing normative attitudes, an individual can signal to others that they are an ingroup member who deserves social support. Based on these two assumptions, from an ultimate perspective, individuals who would respond to a socially resolvable challenge by expressing normative attitudes would have higher fitness than individuals who would not express normative attitudes to such a challenge. In other words:

...if the social benefits of norm adherence are the ultimate cause of the individual's subscription to worldviews, then the focus and salience of a given individual's ideology can be expected to vary as a function of their need to ally themselves with relevant others. Moreover, if the benefits of social inclusion are particularly important in times of need... then natural selection can be expected to have shaped human psychology such that, when confronted with emergency situations that are best addressed using coalitional support, individuals should exhibit a strongly pro-normative orientation in order to enhance the maintenance and formation of alliances (Navarrete & Fessler, 2005, p. 307).

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¹ A third candidate explanation could be derived from terror management theory (TMT; Burke et al., 2010; Renkema et al., 2008). According to TMT, threats to the self should increase normative behavior. If one assumes that a salient infection risk is a threat to the self, then TMT generates the prediction that infection risk should increase conformity. However, work on TMT seems not to have proposed such an explanation. Work on TMT seems not to have considered pathogens as threats to the self, and it seems there are no studies of TMT that have included a manipulation of pathogen threat (Burke et al., 2010). So, although asking people to think of their own death might lead to some pathogen-relevant ideation (e.g., decaying corpses, worms), TMT theorists seem to not have thought that the pathogen-aspect or its associated emotion (disgust) is driving the effects of mortality salience. Therefore, we do not elaborate on this possible explanation.

This general argument is combined with a third assumption that infectious disease is a challenge that can be addressed with social support (Navarrete & Fessler, 2006). In the absence of a modern healthcare system, people who are ill require social support for care, food, safety, and childcare. Put together, the social support account provides the following explanation for the relation between pathogen avoidance motivations and conformity. Over the course of human evolution, help from an ingroup was crucial for health care. People who used normative attitudes to signal their ingroup membership when faced with the threat of infectious disease would have received more health care than those who did display normative attitudes. Therefore, there was selection for a psychological mechanism that outputs normative attitudes contingent on perceiving the threat of infectious disease.

The protective norms account provides an alternative explanation. The protective norms account assumes that conformity is sometimes an effective strategy to address the problem of infectious disease (Murray & Schaller, 2012; Murray et al., 2011; Schaller & Murray, 2011). Pathogens require different actions than predators or toxins (Schaller, 2015). Humans often cannot perceive pathogens directly (as they are typically too small) and only particular behaviors effectively protect against contamination (e.g., you cannot scare pathogens away, but you can boil them to death). Given these features, it is plausible that conformity is sometimes an effective strategy to avoid or diffuse infection risk. Consider for example food preparation. Rather than using trial-and-error learning to arrive at a safe way of preparing a novel food, an individual could copy the procedures used by others. If others prepare food in a certain way, and if they are healthy, it is probably sufficiently safe. From an ultimate perspective, individuals who respond to an increased risk of infection with greater conformity to ingroup norms would have suffered less from infectious disease (and presumably had higher reproductive fitness) than individuals who would not upregulate

conformity when faced with infection risks. Hence, there could have been selection for a psychological mechanism that increases conformity contingent upon cues of infection risk.

How would such a psychological mechanism work? When discussing several candidate explanations for the cross-cultural relation between infectious disease and conformity (see below), Murray and colleagues (2011, p. 327) elaborate on the possibility that a psychological mechanism causes immediate effects of cues of pathogens on conformity:

[Another] kind of explanatory mechanism is more fundamentally social psychological in nature and focuses on the effects of immediate perceptual contexts on social behavior. Individuals' behavioral tendencies toward conformity—and their cognitions bearing on those behaviors—vary as a function of perceptual cues indicating the presence of threats in their immediate social context...It is plausible, therefore, that just as perceptual information indicating the imminent threat of infectious disease causes individuals to be more xenophobic and less extraverted, this perceptual information may also incline individuals to favor less risky, more conformist behavioral strategies. Under ecological conditions in which disease-connoting perceptual information is more chronically salient (conditions of high pathogen prevalence), the implication is a chronically greater inclination toward conformity.

Empirical Evidence

What is the evidence for such a psychological mechanism? The evidence for a relation between pathogen avoidance and conformity comes from three kinds of studies: studies of cross-cultural differences, studies of individual differences, and psychological experiments. We briefly review each of these.

Cross-Cultural Studies

There is variation across cultures in the degree to which people conform to norms (Bond & Smith, 1996). In some societies, norms are *loose* and people are tolerant toward deviation from norms and traditions, whereas in other societies norms are *tight* and people are less tolerant toward deviation. (Gelfand et al., 2011). Some work has examined whether some

of this cross-cultural variation in conformity can be attributed to the behavioral immune system. In an analysis of cross-country differences, Murray and colleagues (2011) tested the hypothesis that in societies with historically higher levels of infectious disease, cultural norms promoting conformity were more likely to emerge and persist. They found that historical pathogen prevalence, an index of infectious disease at the start of the 20th century, was associated with higher conformity as measured with four indexes: (i) the average effect size of behavioral conformity observed in experiments; (ii) the estimated percentage of the population who prioritize that children learn to be obedient; (iii) estimated variability in personality traits (where lower variability in traits reflects greater conformity); (iv) and the estimated proportion of the population who is left-handed (following the assumption that right-handedness is universally normative).

Associations between the level of infectious disease in a geographical region or country and manifestations of conformity are supported by several other studies that have examined cross-cultural differences. Higher levels of infectious disease were found to be associated with collectivism (Thornhill et al., 2008), tight norms (Gelfand et al., 2011), authoritarianism (Murray et al., 2013), moral values of authority and tradition (Van Leeuwen, et al., 2012), traditionalism (Tybur et al., 2016), and lower openness to experience (a personality trait for which lower scores reflect more conformity; Schaller & Murray, 2008). The relation between infectious disease and conformity is also supported by an analysis of cultural differences in non-industrialized societies as documented by anthropologists. In samples of small-scale or non-industrial societies described in the Standard Cross-Cultural Sample, higher levels of infectious disease correlated with socializing children so that they are obedient rather than self-reliant (Cashdan & Steele, 2013) and with measures of cultural tightness (Jackson et al., 2019). This association of pathogen prevalence and conformity is one specific example of a more general relation between socio-ecological threats (e.g., harsh

climates, natural disasters) and psychological, cultural, and political manifestations of conformity and conservatism (Gelfand et al., 2011; Conway et al., 2017; Conway et al., 2020). But, while there is substantial evidence for the cross-cultural pattern, such correlations over aggregated data are not optimal for testing hypotheses about the underlying psychological processes (Hruschka & Hackman, 2014; Pollet et al., 2014).

Individual Differences

Multiple studies of the relation between the behavioral immune system and conformity have examined individual differences, for example assessing the degree to which tendencies to conform relate to individual differences in motivations to avoid pathogens. These studies show that people who are by disposition more motivated to avoid pathogens have a tendency to report traits and attitudes related to conformity to ingroup norms. For example, one study among US citizens showed that individual differences in perceived vulnerability to disease was correlated with ethnocentrism (Navarrete & Fessler, 2006, study 1). Other studies have reported similar correlations with different measures. In a sample of Canadian students, germ aversion (though not perceived infectability) correlated with self-reported conformist attitudes, liking for people with conformist traits, and valuing obedience (Murray & Schaller, 2012). In a similar study among Chinese students, both germ aversion and perceived infectability correlated with self-reported conformity (Wu & Chang, 2012, study 1).

This association is consistent with patterns of individual differences observed in studies of ideology, moral values, and personality. More broadly, a large amount of evidence shows that people who perceive more threats (or are more worried) also tend to have more conservative ideology and worldviews (e.g., Jost et al., 2003; Perry et al., 2013). However, recent work suggests that this relation varies across the type of threat, political domain, and country (Brandt et al., 2020). More specifically, a meta-analysis showed that individual

differences in pathogen avoidance motivations (such as pathogen disgust sensitivity or germ aversion) were reliably related with social conservatism, a facet of ideology that includes conformity to ingroup norms (Terrizzi et al., 2012). In addition, individual differences in pathogen avoidance motivations were found to correlate with traditionalism (Tybur et al., 2016), moral values emphasizing obedience to ingroup authorities and adherence to ingroup norms (Van Leeuwen et al., 2017), and lower openness to experience (Duncan et al., 2009; Tybur & De Vries, 2013).

In short, there is substantial evidence that individuals who are by disposition more avoidant of pathogens are also more prone to conform to ingroup norms. However, such an association between individual differences does not provide specific evidence for the proposed psychological mechanism. The association is also consistent with a slower developmental process in which pathogen avoidance motivations influence the development of traits related to conformity.

Experimental Evidence

Better evidence for the proposed psychological mechanism would come from experiments. We have found four published experiments that included a manipulation of pathogen avoidance motivations (e.g., showing images of pathogen-relevant stimuli such as feces that evoke pathogen disgust) and a measure of conformity. In one study, experimentally increased pathogen disgust increased ethnocentrism, as measured by increased liking of an ingroup member who displays a positive opinion about the ingroup (Navarrete & Fessler, 2006, study 2). In three other experiments, increased pathogen disgust increased self-reported conformity (Wu & Chang, 2012, study 3), conformity to the group average when evaluating modern art paintings (Wu & Chang, 2012, study 2), and behavioral conformity as measured by whether participants conformed to the majority opinion when casting a vote (Murray & Schaller, 2012). In summary, there is some experimental evidence supporting the notion of a

fast-acting mechanism that increases conformity to ingroup norms when perceiving infection risks.

Evaluation of Existing Experimental Evidence

We think that the current experimental evidence for a psychological mechanism that regulates conformity based on pathogen avoidance motivations is insufficient. First, a meta-analysis of the effects of experimental manipulations of disgust on moral judgments shows that inductions of disgust do not have substantial effects on moral judgments (Landy & Goodwin, 2015). Moral judgments often afford expressions of conformity (e.g., agreeing that stealing is wrong) or deviance (e.g., disagreeing that stealing is wrong). Hence, if disgust would have strong effects on conformity, then disgust should also have some effect on moral judgments. Therefore, the absence of effects of disgust-inductions on moral judgments is consistent with pathogen disgust having no strong effect on conformity. This implication is tentative though, because the meta-analysis by Landy and Goodwin (2015) did not specifically examine the effects of pathogen disgust, and it is possible that different kinds of disgust relate differently to moral judgment and conformity.

Second, work on another conceptually relevant experimental effect is equivocal. Above, we mentioned that a relation between pathogen avoidance and conformity is consistent with theories stating that mortality salience increases worldview defensive, such as affirming existing ideologies—which often involves conformity—and increasing self-esteem. Meta-analyses of the effects of morality salience manipulations show that these have substantial effects on attitudes, cognitions, behaviors, and affect (Burke et al., 2010) and also on political attitudes and voting behavior (Burke et al., 2013). However, a recent project aimed at replicating a seminal experiment on morality salience that consulted the original authors for the study design concluded that “the original finding was either a false positive or the conditions necessary to obtain it are not yet understood or no longer exist” (Klein et al.,

2019, p. 2). Thus, the state of the evidence on the effect of mortality salience on worldview defense does not warrant strong confidence that experimental manipulations that increase threats to the self trigger normative responses.

Third, some work that has examined the 2014 Ebola outbreak as a natural experiment of the effect of pathogen threat and political and social attitudes. Beall et al. (2016) analyzed data from before and after the outbreak and reported that the outbreak increased intentions for conservative candidates, but also that this was moderated by a bandwagon effect, that is, conformity to local voting norms with an increased preference for candidates that were leading in local elections or candidates of parties that typically win in that state. However, their analysis was criticized for failing to control for temporal autocorrelation (Tiokhin & Hruschka, 2017). Re-analyses of the data showed no support that the outbreak caused a bandwagon effect (conformity to local voting norms), but did show some support that it increased intentions to vote for conservative candidates (Schaller et al., 2017). In addition, Inbar et al. (2016) examined whether the Ebola outbreak increased sexually conservative attitudes, operationalized as implicit and explicit attitudes towards gay men and lesbian women. Findings were mixed with support for a conservative shift on some measures but not others, leading to the conclusion that “the shift, if it does exist, is very small” (p. 426).

The evidence reviewed above is conceptually similar enough that it should inform our prior about whether a pathogen concern-conformity link exists, but conceptually distinct enough that it should not be counted as direct evidence for this specific link. Therefore, we take a closer look at the prior experiments. This reveals that the evidence they provide is not strong. Each of the experiments has at least one limitation that reduces confidence in internal validity. In the experiment reported by Navarrete & Fessler (2006), the treatment that increased infection risk involved asking half of the participants to complete the Disgust Scale (Haidt et al., 1994), whereas the participants in the control condition did not complete this

scale. As this study did not include a manipulation check, it is uncertain whether the treatment actually increased worries about infectious disease or feelings of disgust. Although the items of the Disgust Scale probably triggered some pathogen-relevant ideation (the scale includes pathogen-relevant items such as “You are about to drink a glass of milk, when you smell that it is spoiled”), it is not certain that this procedure provided a successful manipulation of pathogen threat.

The experiment by Murray and Schaller (2011) included five other measures of conformity in addition to behavioral measure described above. Across the six measures, the findings were not consistent. For the four primary measures, the pathogen threat manipulation (compared to the neutral control) only significantly increased scores for the behavioral measure of conformity. Unfortunately, as the authors discuss, this was also the only measure that could have been influenced by experimenter effects (due to the nature of the behavioral measure in that study, the experimenter was not blind to the participant’s condition). For the other three primary measures, the effects were not significant. Of the two secondary measures of conformity, only one showed a significant effect of the pathogen threat manipulation. In addition, as the sample size in this study was small (for the primary measures there were 61 to 82 participants per condition, for the secondary measures there were 23 to 39 participants per condition), these inconsistent effects do not constitute strong evidence. In addition, the two experiments reported by Wu and Chang (2012, studies 2 and 3) also involved small samples. In one experiment there were fewer than 30 participants per condition and in the other experiment there were 34 in the pathogen threat condition and 26 in the control condition. Taken together, there is some experimental evidence for an immediate effect of salient infection risk (or its associated emotion, pathogen disgust) on conformity, but this evidence is not strong.

Theoretical Issues

In addition, we believe that both the social support account and the protective norms account suffer from unresolved theoretical issues. The social support account faces two issues. The first relates to the assumption that conformity is an effective strategy of recruiting social support. While there is ample support that conformity helps buffer against the risk of ostracism (Chartrand & Lakin, 2013; Wesselmann et al., 2014), illness is different. Illness requires high-level investments from others in terms of care and calorie-provision and, hence, requires a substantial positive evaluation of the self rather than simply the absence of negative evaluations. Rather than displaying conformity and indirectly signaling that you are a member of the ingroup, positive evaluations can be more effectively generated by reminding people that you are valuable to them (e.g., having shared food with them when they needed it, having valuable skills, etc.). Indeed, work on friendship has argued that to make a friend, to create a relationship that provides help to you even when there is a low probability for you to reciprocate the favor, you should try to become irreplaceable to the other person (Tooby & Cosmides, 1996), for example by signaling commitment (DeScioli & Kurzban, 2009; DeScioli et al., 2011).

The second theoretical problem for the social support account also relates to what would be an effective strategy for recruiting social support. Why make seeking social support contingent on salient pathogen threat? A psychological mechanism that upregulates conformity based on moment-to-moment monitoring of infection risk in the local environment might not achieve the optimal level of conformity for gathering social support. Gathering social support might take prolonged efforts. Therefore, starting to recruit social support when infection risk is imminent, might simply be too late. In addition, as assumed in the social support account, social support is useful not just for health care, but for dealing with diverse adaptive challenges. Therefore, seeking social support contingent on cues of

infection risk seems not an optimal strategy for maintaining such a crucial resource as social support. Consistent with the notion that social support is essential, people seem to seek social support (e.g., make friends, forge alliances, build coalitions) spontaneously, not just when the need for support arises (Tooby, Cosmides, & Price, 2006). People have a need for social relationships (Baumeister & Leary, 1995) and seeking social support appears contingent on cues that one will not receive sufficient social support (e.g., having recently been rejected; Maner et al., 2007).

We think that the protective norms account also faces a theoretical issue. The protective norms account assumes that conformity is an effective strategy for pathogen avoidance because norms embody precautionary knowledge. That is, the assumption is that following norms will prevent that a latent threat (e.g., the probabilistic risk of infection posed by a meal) becomes a manifest threat (e.g., consumption of spoiled food). However, people perceive myriad latent threats and develop protective rituals aimed at reducing, containing, or neutralizing these latent threats. Such rituals are typically not triggered by the presence of a manifest threat, but aim at removing or neutralizing an inferred or latent threat (Boyer & Lienard, 2006). Precautionary behaviors are geared to target latent rather than manifest threats. Indeed, this is why people are able to engage in precautionary behaviors and, for example, take vitamin supplements when healthy and floss when their teeth are in good condition. Hence, the proposal that conformity serves a precautionary or preventive function in neutralizing infection risks, suggests that conformity should also occur when infection risks are latent (and cues of manifest infection risk are absent). The theoretical issue is not that conformity is unlikely to serve a precautionary function, but rather that the proposal that its expression is contingent on the threat being present (manifest), is inconsistent with the

view that precautionary behaviors are generally not caused by perceiving a salient or manifest threat.²

Overview of Current Research

We conducted six experiments in which we manipulated pathogen avoidance motivations and measured conformist tendencies. In each experiment, an increase in conformity in the pathogen avoidance condition would count as support for a causal relation between pathogen avoidance motivations and conformity. In other words, increases in conformity would support the notion that the behavioral immune system has design features that upregulate conformity when perceiving pathogen cues. In contrast, if conformity does not increase in the pathogen avoidance condition, then this would suggest that pathogen avoidance motivations do not have an immediate effect on conformity. Across the six studies we recruited samples from different populations, used different measures of conformity, and different manipulations of pathogen avoidance motivations (see Table 1). Prior work suggests that a broad range of manipulations is suitable for increasing pathogen avoidance motivations, such as images of situations with pathogen cues (e.g., Park et al., 2007; Schaller et al., 2010), images that increase state disgust (Wu & Chang, 2012), guided recall of situations with increased infection risk (Murray & Schaller, 2012), and questions-as-treatment procedures that present survey questions that are likely to trigger disgusting thoughts to participants (Navarrete & Fessler, 2006). We manipulated pathogen avoidance motivations both with disgust-evoking images of pathogen cues (e.g., feces, spoiled food, see

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² One might argue that it could be functional to express precautionary behaviors more strongly (or more frequently) when cues indicate that the threat is likely to manifest. This reveals the following unresolved issues. First, if an agent could estimate the likelihood of the manifest threat, then why perform precautionary behaviors at all? The agent could refrain from precautionary behaviors when the threat is absent and engage in protective behaviors when the threat is manifest. Second, are manifest and latent threats typically neutralized by the same actions? It seems that at least sometimes, effective precautions (e.g., locking the door at night against intruders, cooking meat, vaccines) require different actions than neutralizing manifest threat (e.g., calling the police, not eating spoiled meat, anti-viral drugs). While it is possible that conformity is a useful strategy to neutralize both latent and manifest threats, this is not evident.

Studies 1, 4, and 6) and questions that asked participants to imagine contact with people with cues of infectious disease (see Studies 2 and 3). We used a guided-recall task in Study 5.

Finally, we performed an internal meta-analysis to assess support for the main hypothesis across the studies.

We derived two additional hypotheses to distinguish the social support and protective norms account. The social support predicts that the effect of pathogen avoidance on conformity should be stronger for a measure of conformity that captures self-presentation as a loyal member of the ingroup, than for a measure of conformity that captures aversion to violations of hygiene norms, whereas the opposite prediction would be made by the protective norms account. We tested these additional hypotheses in Studies 1 and 2.

Finally, each study also included a measure of individual differences in pathogen avoidance motivations (i.e., pathogen disgust sensitivity; Tybur et al., 2009). We used this variable in additional analyses that examined whether individual differences in pathogen avoidance related to conformity.

Table 1: Overview of samples, methods, and results of Studies 1-6.

Study	Sample description	Survey language	Sample size N (treatment, control)	Manipulation	Dependent variable	Treatment condition M (SD)	Control condition M (SD)	t	df	p	Cohen's d
1	Dutch-speaking internet users	Dutch	213 (109, 104)	Disgust-inducing images	One of four DVs: - Conformity to loyalty norms - Conformity to hygiene norms - Aversion to loyalty violations - Aversion to hygiene violations	5.41 (0.76) n=32 5.65 (0.69) n=26 4.58 (1.15) n=31 4.95 (1.10) n=20	4.88 (0.96) n=22 5.18 (1.06) n=25 4.30 (1.62) n=24 5.41 (1.20) n=33	2.29 1.87 0.74 -1.40	52 49 53 51	.026 .067 .464 .168	0.63 0.52 0.20 -0.40
2	Students and Dutch-speaking internet users	Dutch or English	509 (256, 253)	Imagined contact	One of four DVs: - Conformity to loyalty norms - Conformity to hygiene norms - Aversion to loyalty violations - Aversion to hygiene violations	4.36 (0.75) n=56 5.43 (0.95) n=51 4.57 (0.99) n=77 5.47 (0.98) n=72	4.61 (0.71) n=79 5.66 (0.73) n=49 4.84 (0.86) n=59 5.57 (0.92) n=66	-1.98 -1.32 -1.66 -0.60	133 98 134 136	.050 .190 .100 .549	-0.35 -0.26 -0.29 -0.10
3	Dutch internet users	English	155 (70, 85)	Imagined contact	Liking of ingroup member that expresses a pro-ingroup attitude	0.82 (1.25) n=64	1.24 (1.49) n=79	-1.77	141	.078	-0.30
4	Students	Dutch or English	276 (138, 138)	Disgust-inducing images	Two DVs: - Conformity to group average when evaluating modern art paintings - Conformity to group norm when this entails infection risk	1.63 (0.61) n=138 2.30 (1.27) n=137	1.67 (0.60) n=138 2.12 (1.14) n=137	0.50 1.18	274 272	.618 .240	0.06 0.14
5	US residents	English	279 (141, 138)	Guided-recall task	Aggregate index of four measures of conformity	-	-	-	-	-	-
6	US residents	English	790 (389, 401)	Disgust-inducing images	Aggregate index of four measures of conformity	0.032 (0.59) n=389	-0.031 (0.58) n=401	1.51	788	.131	0.11

Study 1

For all studies reported below, we obtained informed consent from all participants at the start of the survey. The study procedures were approved by the Ethics Review Board of the [REDACTED]. All materials, data, and code are available on the Open Science Framework via [anonymous link for peer review: https://osf.io/84vzp/?view_only=672974c97c154a479bb6dfc439b612].

Method

Study 1 was not pre-registered. Participants ($N = 213$) were recruited via social media in January-February 2019 and completed an online survey.

The study included a between-subjects manipulation of pathogen avoidance motivations using images from the Culpepper Disgust Image Set (Culpepper et al., 2018), which includes images that reliably induce the emotion pathogen disgust and a set of neutral control images. We selected 10 images previously shown to trigger disgust: images 1 (dirty sanitary item), 2 (dirty unflushed toilet), 3 (bad dental hygiene), 4 (eating snot boogies), 11 (decomposing animal carcass), 12 (rotting meat), 13 (liquid rubbish), 14 (stepping in dog feces), 17 (infected wound oozing pus), and 20 (vomit). We used the ten corresponding pathogen-free images from the Image Set for the control condition. To encourage participants to view the photos attentively, participants were asked to evaluate each image on a 7-point scale from *very negative* to *very positive*. A measure of state disgust was included as a manipulation check, it was assessed immediately after watching the images (“How much disgust do you experience at the moment?”, rated on an 11-point scale from “0 = No disgust at” all to “10 = Very much disgust”). All materials are reported in the Supplementary Materials.

With this between-subjects design, the key comparison is the difference in conformity between the treatment condition (i.e., increased pathogen avoidance motivation) and the control condition. Previous experiments suggest that the effect size for this comparison is in the range of $d = 0.30$ to 0.50 . Wu & Chang (2012) reported values of $d = 0.64$ and 0.54 . From results reported by Navarrete & Fessler (2006), we estimated $d = 0.32$. From results reported by Murray & Schaller (2012), we estimated $d = 0.54$ for the aggregate conformity index. To achieve power = .80 to detect a significant difference would require $N = 128$ when assuming $d = 0.5$ and $N = 352$ when assuming $d = 0.3$ (for a two-tailed t -test with $\alpha = .05$). A sensitivity analysis showed that the current study had power of .80 for a minimum effect size of 0.39 (for the difference between the treatment and the control condition). The study was underpowered to test for the three-way interactions for the additional hypotheses to distinguish the social support and protective norms account.³

The study included novel measures of conformity that were designed to test specific hypotheses derived from the social support and protective norms accounts. We assumed that people may express conformity in at least two different ways, as self-reported norm-following (i.e., self-presentation) and as aversion towards others who violate a norm. We included measures of self-presentation and aversion to norm violations. In addition, we varied the content of the norms being considered: participants completed items either related to norms of ingroup loyalty or to norms about hygiene. Thus, norm following was measured by asking participants to rate their agreement with statements in which the self was described as a loyal member of their group (12 items, e.g., “I never betray my group”, Cronbach’s $\alpha = .88$) or as a hygienic person (10 items, e.g., “I never sneeze in the direction of other people”, Cronbach’s $\alpha = .84$), on a 7-point scale from *strongly disagree* (1) to *strongly agree* (7).

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³ Power analysis for interaction effects are complicated. Recent work suggests that if for a comparison between two conditions, we assume an effect of $d = 0.5$ (which would require $N = 128$ for power = .80) then testing a hypothesis about a three-way interaction attenuating the main effect would require 16 times as many participants, $N = 2048$, to maintain power at .80 (Blake & Gangestad, 2020).

Aversion to norm violations was measured by asking participants to evaluate another person of the same sex and age who uttered a statement indicative of a norm violation. Aversion to norm violations was measured with statements about loyalty violations (12 items, e.g., “I often betray my group”, Cronbach’s $\alpha = .94$) or statements about hygiene violations (10 items, e.g., “I often sneeze in the direction of other people”, Cronbach’s $\alpha = .92$) all rated on a 7-point scale from *I would not view him/her negatively at all* (1) to *I would view him/her very negatively* (7). Participants were randomly assigned to complete one the four measures of conformity.

The survey included questions to measure sex and age and items from the Three-Domain Disgust Scale (TDDS; Tybur, Lieberman, & Griskevicius, 2009). The TDDS includes seven items that measure pathogen disgust sensitivity, which reflects individual differences in pathogen avoidance motivations. Respondents indicated how disgusting they find the activity described in the item (e.g., “Accidentally touching a person’s bloody cut,” 0 = *not at all disgusting*, 6 = *extremely disgusting*). The survey included additional items unrelated to the current study.

Results

We followed a two-step approach. First, we assessed whether the treatment was successful in increasing pathogen avoidance motivations. Second, we estimated the effect of the treatment on conformity.

The manipulation was successful in increasing pathogen avoidance motivations. Participants in the treatment condition reported feeling more disgusted, $M = 7.09$, $SD = 3.15$, than participants in the control condition, $M = 2.45$, $SD = 1.99$, $t(211) = 12.77$, $p < .001$. The effect size for this difference was large, Cohen’s $d = 1.75$.

Did the infection risk manipulation increase conformity? We computed a factorial three-way ANOVA including three factors: condition (pathogen avoidance vs. control), type

of conformity (adherence to norm vs. aversion to norm violation), and type of norms (loyalty norms vs. hygiene norms). The effect for condition was not significant, $F(1, 205) = 2.31, p = .13$. The ANOVA also showed a significant Condition $\times$ Type of conformity interaction, $F(1, 205) = 4.53, p = .035$, which indicated that the effect of Condition was not equivalent across the types of conformity measured. The effect of condition was positive when conformity was measured as adherence to norms ($M_{pathogen} = 5.53, M_{control} = 5.03, t(205) = 2.32, p = .021$), but not when conformity was measured as aversion to norm violations ($M_{pathogen} = 4.76, M_{control} = 4.86, t(205) = 0.43, p = .67$). No other effects were significant.

We examined whether the effect of condition was contingent on controlling for pathogen disgust sensitivity. We included pathogen disgust sensitivity as a covariate, which was significantly related to the conformity measure, $F(1, 193) = 12.78, p < .001$. The effect of condition remained not significant, $F(1, 193) = 3.73, p = .055$, and the Condition $\times$ Type of conformity interaction remained significant, $F(1, 193) = 5.22, p = .023$. There were no other interactions involving the conditions, although there was a significant Type of Norms $\times$ Type of Conformity interaction. We then included all interactions of pathogen disgust sensitivity with the factors. This revealed no significant interaction effect between pathogen disgust sensitivity and condition, $F(1, 186) = 0.51, p = .48$, indicating that the effect of condition was not moderated by pathogen disgust sensitivity. In fact, no effects were significant in this model.

Study 2

Method

Study 2 was pre-registered (anonymous link: <https://aspredicted.org/blind.php?x=gh38ri>). Compared to Study 1, Study 2 used a different manipulation of pathogen avoidance motivations and had a larger sample size, $N = 509$. In

total, 547 participants completed the survey during November 2018-January 2019.

Participants could select the survey language as Dutch or English. Unfortunately, during data processing a translation error was discovered for the answer options for one version of the dependent variable (measure of adherence to hygiene norms, English version). Participants who had completed this erroneous dependent variable ($n = 38$) were excluded from the analysis; this exclusion criterion was not specified in advance. The pre-registration specified that participants would be excluded if they answered fewer than 75% of the items of the dependent variable; this criterion did not yield any exclusions. Due to miscommunication, we deviated from the pre-registered stopping rule (i.e., collect data for two weeks and if $N < 400$ collect data for another week) and more participants completed the survey. A sensitivity analysis showed that the sample size provided power of .80 for a minimum effect size of 0.25. Like Study 1, the study was underpowered for tests for the three-way interactions derived from the social support and protective norms account.

Pathogen avoidance motivations were manipulated by presenting participants with facial photographs of White adult males with or without conspicuous pathogen cues (images were from the Park Aging Mind Laboratory face database; Minear & Park, 2004). In the control condition, unmodified (regular) faces were presented. In the treatment condition all images had been modified to show a conspicuous cue of infection (e.g., inflamed skin, open sores). All participants viewed eight faces and rated each face for comfort with contact (“How would you feel about shaking hands with the person in the picture?” with 1 = *very uncomfortable*, 5 = *very comfortable*) and health (“How healthy does this person look?” with 1 = *very unhealthy*, 5 = *very healthy*). The manipulation thus involved stimuli that are similar to those perceived by the participants in their daily lives when they meet people with or without visible pathogen cues. The questions about contact were included so that participants

imagined physical contact with these individuals.⁴ The ratings for health were aggregated across the eight faces and served as a manipulation check. See the Supplementary materials for details.

Participants completed the same measures of conformity as in Study 1. Reliability of the dependent variables was adequate (Cronbach's α s ranging from .79 to .86). The survey included items to measure pathogen disgust sensitivity and other items unrelated to the current study.

Results

The manipulation successfully increased perceived infection risks. Participants in the treatment condition rated the target individuals as less healthy, $M = 2.31$, $SD = 0.54$, compared to participants in the control condition, $M = 3.20$, $SD = 0.45$, $t(507) = 20.04$, $p < .001$. The effect size for this difference was large, Cohen's $d = 1.78$.

Did the infection risk manipulation increase conformity? Following the pre-registration, we computed a factorial three-way ANOVA including three factors: condition (pathogen avoidance vs. control), type of conformity (adherence to norm vs. aversion to norm violation), and type of norms (loyalty norms vs. hygiene norms). The ANOVA showed no significant effect for condition, $F(1, 501) = 1.65$, $p = .200$. The point estimate for conformity was lower in the infection risk condition ($M = 4.96$) than in the control condition ($M = 5.17$). The ANOVA also showed a significant effect for the type of norms, $F(1, 501) = 43.47$, $p < .001$, indicating that conformity was higher for hygiene norms ($M = 5.53$) than for loyalty norms ($M = 4.60$). No other effects were significant.

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⁴ In contrast with the manipulation used in Study 1, this procedure is not aimed at inducing high levels of disgust. Because feeling disgusted is unpleasant, manipulations that induce high levels of disgust might cause some participants to disengage with the stimuli (e.g., look away), reduce their compliance in the study (e.g., answer questions inattentively), or trigger reactance (e.g., trying to respond as-if they do not feel disgusted). To address these possible limitations of disgust-inductions we developed these alternative manipulations.

We examined whether the effect condition was contingent on controlling for pathogen disgust sensitivity. We included pathogen disgust sensitivity as a covariate, $F(1,491) = 15.43$, $p < .001$. The effect of condition remained non-significant. We then included all interactions of pathogen disgust sensitivity with the factors. This revealed no significant interaction effects, indicating that the effect of condition was not moderated by pathogen disgust sensitivity.

As mentioned above, English-speaking participants who completed the DV for adherence to hygiene norms were excluded from the analysis because of a translation error. This may have introduced differences between the participants in the conditions. To account for this, we performed an additional analysis. We computed the three-way factorial ANOVA, but with only including Dutch-speaking participants in all conditions ($N = 409$). The effect of condition remained not significant, $p = .19$.

Study 3

Studies 1 and 2 were designed to test specific hypotheses derived from social support and protective norms accounts. In both studies, we found no support for these specific hypotheses, nor for the more general hypothesis that a manipulation of pathogen avoidance motivations affects conformity. Study 3 was designed to test the simpler hypothesis that increased pathogen avoidance motivations increases conformity.

Method

Study 3 was pre-registered (anonymous link: <https://aspredicted.org/blind.php?x=7jm26b>). In January-February 2019, 364 participants responded to an online survey. Because of how conformity was measured, the analysis was restricted to Dutch citizens, giving $N = 155$. This exclusion rule was specified in advance. A sensitivity analysis showed that the study had power of .80 for a minimum effect size of 0.46.

Study 3 included the same manipulation of pathogen avoidance motivations as in Study 2, with the perceived health of the targets rated on an 11-point scale from *Very ill* (-5) to *Very healthy* (+5). Study 3 included a measure of conformity similar to the one used in a prominent study about pathogen avoidance and conformity (Navarrete & Fessler, 2006). This measure operationalized conformity as adherence to ethnocentric pro-ingroup norms. We included the 7-item measure of ingroup attraction used by Navarrete & Fessler (2006, study 2). Participants first read a negative opinion about their ingroup (i.e., people of the Netherlands) ostensibly written and posted on the internet by an immigrant. Then participants completed seven items that measure their liking of the author of the anti-ingroup essay (e.g., “How likeable is the author of this opinion?”, “How intelligent is the author?”, all items rated on a 9-point scale from -4 to +4 where -4 reflected a negative evaluation and +4 reflected a positive evaluation). Subsequently, participants read a positive opinion about their ingroup (i.e., people of the Netherlands) ostensibly written and posted on the internet by a Dutch person. Participants then completed the same seven items that evaluated the author of the pro-Dutch opinion. The evaluation of the pro-Dutch author served as the measure of ethnocentrism (Cronbach’s $\alpha = .93$). This measure of ethnocentrism reflects conformity in the sense that norms typically prescribe expressing positive rather than negative attitudes toward ingroup members. (As mentioned above, given the nature of this measure, the analysis only included participants who indicated Dutch citizenship.)

The survey included items to measure pathogen disgust sensitivity and other items unrelated to the current study.

Results

The manipulation successfully increased perceived infection risks. Participants in the treatment condition rated the target individuals as less healthy ($M = -0.90$, $SD = 1.58$)

compared to participants in the control condition ($M = 1.17$, $SD = 1.25$), $t(144) = 8.83$, $p < .001$. The effect size for this difference was large, Cohen's $d = 1.47$.

Did the infection risk manipulation increase conformity? We regressed ethnocentrism on condition (0 = control, 1 = infection risk) and following the pre-registration we included sex, age, and pathogen disgust sensitivity as predictors. The effect for condition was not significant, $b = -0.36$, $SE = 0.23$, $t(128) = -1.55$, $p = .123$. Note that the sign for the point-estimate of the effect was negative, indicating an effect in the opposite direction to the hypothesis. We examined whether the effect of condition was moderated by pathogen disgust sensitivity, but the Condition $\times$ Pathogen disgust sensitivity interaction was not significant, $b = 0.13$, $SE = 0.14$, $t(127) = 0.92$, $p = .36$.

Study 4

Method

Study 4 was a pre-registered replication of a published experiment (Wu & Chang, 2012, study 2), but with a larger sample size (anonymous link: <http://aspredicted.org/blind.php?x=yq4zg6>). Two-hundred ninety-seven participants completed an online survey in April 2019. The pre-registration specified exclusion of participants who provided the same response for all items on each of the dependent variables. Following this exclusion rule, two participants were excluded. In addition to this pre-registered exclusion rule, a single participant expressed skepticism about one of the dependent variables and was therefore excluded from the analysis, resulting a final sample size of $N = 276$. A sensitivity analysis showed that the study had power of .80 for a minimum effect size of 0.34.

The study included a between-subjects manipulation of pathogen avoidance motivations similar to that used in Study 1. Pathogen avoidance was manipulated by presenting the same images from the Culpepper Disgust Image Set (Culpepper et al., 2018),

but with images 11 and 13 dropped and replaced with images 7 (worms in food) and 8 (dirty fungus infected toenails). To encourage participants to view the photos attentively, participants were instructed to pay attention to the photos because they would have to answer questions about them afterwards. Each photo was then presented for at least 4 seconds after which participants could click a button to proceed to the next image. We used the 10 corresponding pathogen-free images for the control condition. All materials are reported in the Supplementary Materials. The survey included questions measuring state disgust, i.e., how disgusted participants felt at that moment, rated on a scale from *Not at all* (1) to *Very much* (7), which served as the manipulation check. State disgust was assessed after participants had completed the first dependent variable.

Participants completed two measures of conformity, one without pathogen cues and one with pathogen cues. The first measure was similar to that used by Wu & Chang (2012). This measure involved participants rating 10 modern art paintings. For each painting participants were shown the average rating of a sample of students from the same university that had participated in a pilot study. The measure of conformity was the absolute difference between the participants rating and the average rating shown. For this absolute difference score, lower values indicate higher conformity. Reliability of this measure was sufficient (Cronbach's $\alpha = .73$).

The second dependent variable was included to assess whether infection risk manipulation influenced how participants traded-off pathogen avoidance versus conformity to an ingroup. Participants were presented with a vignette that asked them to imagine that they were planning to go on vacation with a group of friends and that their friends picked a vacation house to rent. The vignette explained that all other members of the group already had agreed with the choice for the vacation house and that they just wanted to know whether the participant also agreed. The participant was then shown pictures of the vacation house

which showed that the house had a dirty bathroom with mold. In this context, conformity with the majority decision—agreement to rent the dirty vacation house—would constitute prioritizing conformity over pathogen avoidance. In contrast, deviance from the majority decision—disagreement with renting the dirty vacation house—would constitute prioritizing pathogen avoidance over conformity. Agreement to rent the dirty vacation house was measured with four items (e.g., “I would certainly approve of the group’s choice for this holiday home,” “I would never accept the choice of this holiday home” [reverse scored]), rated on a 7-point scale from *strongly disagree* (1) to *strongly agree* (7), Cronbach’s $\alpha = .87$. The survey also included items to measure pathogen disgust sensitivity.

Results

The manipulation successfully increased pathogen avoidance motivations. Participants in the treatment condition ($M = 4.37$, $SD = 1.73$) reported feeling more disgusted than participants in the control condition ($M = 2.13$, $SD = 2.13$), $t(274) = 12.11$, $p < .001$. The effect size for this difference was large, Cohen’s $d = 1.46$.

Did the infection risk manipulation increase conformity? For both dependent variables, the index of deviant evaluations of modern art and the conformity to the vacation group, a t-test revealed no significant difference (see Table 1). To control for individual difference variables, we regressed the deviance score on condition (0 = control, 1 = infection risk), age, sex, and pathogen disgust sensitivity. The effect of condition remained not significant, $b = -0.04$, $SE = 0.07$, $t(267) = -0.55$, $p = .58$. We also regressed conformity to the vacation group on condition, age, sex, and pathogen disgust sensitivity. The effect of condition remained not significant, $b = 0.14$, $SE = 0.14$, $t(266) = 0.96$, $p = .34$.

Study 5

Study 5 was designed as a close replication of the experiment reported in Murray and Schaller (2012), one of the key studies on the relation between pathogen avoidance and

conformity. Study 5 was pre-registered (anonymous link: https://aspredicted.org/XPR_16B).

We consulted with the first author of the original study to verify that our materials and procedures resembled those of the original study. The original study manipulated pathogen avoidance motivations via a guided recall that was administered by the experimenter in a face-to-face interview. When we collected data for this study (May 2021), it was not feasible to do face-to-face interviews with a large sample of participants due to COVID-19 restrictions. Therefore, we adjusted the materials to an online survey and collected data from US residents via Prolific. Because there was uncertainty whether the manipulation would be effective in an online survey, we pre-registered to collect the data in batches. In batch 1 we collected data from 280 participants, for which we evaluated whether the pathogen avoidance manipulation was successful at (1) increasing state disgust compared to the control condition, and (2) inducing disgust, but not fear. We included this second criterion because in the original study, the manipulation was designed to be specific to disgust (i.e., it involved recall of disgusting situations more so than fear-evoking situations). With 280 participants, the power for each of these tests (assuming $d = 0.3$) is .80 and .99, respectively. If the manipulation check were to indicate successful manipulation of disgust then we would collect the remaining participants in a second batch. Unfortunately, the manipulation checks indicated that the manipulation did not work as intended. The manipulation increased state disgust in the treatment condition ($M = 2.79$, $SD = 1.78$) compared to the control condition ($M = 1.37$, $SD = 0.98$, $t(277) = 8.24$, $p < .001$, Cohen's $d = 0.99$). However, the manipulation did not specifically increase state disgust. In the treatment condition, state disgust was not substantially higher (i.e., with $p < .05$ and an effect size of at least 0.3) than state fear ($M = 2.45$, $SD = 1.60$, $t(140) = 2.71$, $p = .0076$, Cohen's $d = 0.20$). Following the pre-registration we stopped data collection. See the Supplementary Materials for details of the methods.

Study 6

Study 6 was similar to Study 5 and was designed as a replication the experimental findings reported in Murray and Schaller (2012), but with a different manipulation of pathogen avoidance motivations. Study 6 was pre-registered (anonymous link: https://aspredicted.org/43R_KY7).

Method

Procedure

To manipulate pathogen avoidance motivations, we used images from the Culpepper Disgust Image Set (Culpepper et al., 2018) as in Studies 1 and 3. In the pathogen threat condition, participants were shown images 2, 3, 6, 7, 11, 12, 14, 15, 17, and 20 from the set. In the control condition, we used the corresponding pathogen-free images.

We used the same dependent variables as in Study 5. Participants completed four measures of conformity, three of which—self-reported conformist attitudes (6 items), liking for people with conformist traits (3 items), valuation of obedience (1 item)—were the same as those used by Murray and Schaller (2012). The fourth measure was similar but not identical to the behavioral measure used by Murray and Schaller (2012). Originally, the behavioral measure asked participants to indicate their agreement or disagreement with a proposal about an education policy at their university. Conformity was operationalized as expressing the majority opinion. In order to adjust this behavioral measure to an online context, we asked people whether they agreed or disagreed with the statement “The National Science Foundation should increase its budget for research of the biodiversity in Antarctica.” The instructions mentioned that in a survey one year prior we had also asked about this issue and that this previous survey indicated that a majority agreed (or disagreed, randomized across participants) with the statement. Conformity was operationalized as selecting the

majority opinion. The order of the four measures of conformity was randomized across participants. To test the hypothesis, we followed the original study and computed an aggregate index of these four measures by standardizing each measure and then computing the mean score.

Participants then rated the emotions they experienced during the experimental session on 7-point scales from *None at all* (1) to *Extremely* (7), this included a measure of state-disgust that served as a manipulation check. Finally, participants reported their political orientation and completed the seven items of the pathogen disgust domain of the TDDS. The survey also included an attention check. Immediately after the last item for pathogen disgust sensitivity, participants were shown the item *Please select 'not at all disgusting'*, with the same seven answer options as for the TDDS. Participants who selected any other answer than “not at all disgusting” were considered to have failed the attention check. Finally, participants were thanked and debriefed.

Participants

We recruited 790 participants (389 participants in the treatment condition, 401 participants in the control condition) that met the inclusion criteria in June 2021. Assuming a population effect size of $d = 0.20$ (which is smaller than that observed in the original study), the required sample size for a two-sided t-test for independent means with 80% power is at least 788 (394 per condition). This sample size would also allow for a small-telescopes analysis (Simonsohn, 2015), which in this case would require a total N of 358. We recruited participants via Prolific from the US population, which is culturally similar to the Canadian population sampled by Murray and Schaller (2012). Hence, differences between this study and Murray and Schaller (2012) cannot easily be attributed to cultural differences between the samples.

Results

The manipulation successfully increased pathogen avoidance motivations. Participants reported significantly higher state disgust in the treatment condition ($M = 5.39$, $SD = 1.78$) than in the control condition ($M = 1.94$, $SD = 1.22$), $t(788) = 31.84$, $p < .001$, Cohen's $d = 2.27$. Participants in the treatment condition reported significantly higher state disgust than state fear ($M = 2.09$, $SD = 1.57$), $t(388) = 34.06$, $p < .001$, Cohen's $d = 1.96$. In addition, state fear was significantly higher in the treatment condition than in the control condition ($M = 1.28$, $SD = 0.84$, $t(788) = 9.09$, $p < .001$, Cohen's $d = 0.64$).

Did the infection risk manipulation increase conformity? Scores for the aggregate index of conformity were not significantly higher in the treatment condition than in the Neutral control condition (see Table 1). We evaluated the robustness of these results. We tested the hypothesis over the full sample (i.e., an intention-to-treat analysis, including all participants who completed the dependent variables) with a two-sided t-test. The difference remained not significant, $t(789) = 1.44$, $p = .15$. To explore whether effects of the manipulation were specific to a particular measure of conformity, we performed a t-test for each of the four measures of conformity (i.e., four two-sided t-tests with p-values corrected for multiple comparisons with the Holm-Bonferroni method). This showed that the manipulation did not influence the scores for self-reported conformist attitudes ($t(788) = 0.71$, $p = 1.00$), liking for people with conformist traits ($t(788) = 0.72$, $p = 1.00$), valuation of obedience ($t(788) = 1.76$, $p = .31$), and siding with the majority opinion ($b = 0.05$, $SE = 0.15$, $z(788) = 0.33$, $p = 1.00$).

Internal Meta-Analysis

We performed an internal meta-analysis to combine the evidence from all five studies. We performed a random effects meta-analysis over the Cohen's d effect sizes reported in Table 1. For Studies 1 and 2 we included the effect sizes for each of the four measures of conformity

(each participant only completed one measure). For Study 4 we included the effect size for the primary DV, the deviance in art ratings. The average effect across the 11 effect sizes was not different from zero, average $d = -0.05$, 95% CI $[-0.21, 0.12]$. See Figure 1 for the forest plot.

We also performed a Bayesian meta-analysis based on t -statistics (Rouder & Morey, 2011) using the BayesFactor package (Morey & Rouder, 2018). We performed a t -test in each of the 11 comparisons testing the difference between the control and treatment condition on the main conformity measure. The resulting t -statistics and condition sample sizes were entered into the meta-analysis, resulting in a Bayes Factor of 19.16 in favor of the null hypothesis. This constitutes strong evidence for the absence of an effect (Jeffreys, 1998).

Figure 1.

Forest plot for the meta-analysis of effects of the infection risk manipulation on conformity.

Note. The effect sizes shown are Cohen's d.

Additional Analysis

Was pathogen disgust sensitivity related to conformity? Each of the studies included a measure of pathogen disgust sensitivity. To assess whether pathogen disgust sensitivity related to conformity, we performed an internal meta-analysis of Fisher z transformed correlations (see Table S1 for all correlations). For Study 4 the correlation for deviance in art

ratings was included (we reversed the sign for this correlation). The average correlation was .15, 95% CI [.08, .22].

Discussion

Five experiments examined the effect of pathogen avoidance motivations on conformity. The internal meta-analysis showed that across these experiments, there was no significant effect of pathogen avoidance manipulations on conformity. The discrepancy between the current results and those of previous experiments cannot be easily attributed to methodological differences or cultural differences between the sampled populations. Compared to previous studies, our studies typically had larger samples, and Study 6 constitutes the most powerful test of the hypothesis to date. To achieve large samples, our studies were implemented as online surveys, but so was one of the directly relevant existing experiments (Navarrete & Fessler, 2006). We tested the hypothesis with samples recruited from Dutch and US populations, in line with the previous work showing that the effect is observed across US, Canadian, and Chinese populations.

Previous experiments used various manipulations, including questions-as-treatment designs (e.g., participants in the treatment condition were asked questions that evoke pathogen-related thoughts or memories of being vulnerable to infectious disease, Navarrete & Fessler, 2006; Murray & Schaller, 2012) and treatments that exposed participants to visual pathogen cues (e.g., images of maggots and wounds, or a video clip about a pandemic, Wu & Chang, 2012). Across the current studies we used three kinds of manipulations similar to those used in previous experiments: Studies 1, 4, and 6 used validated images with visual pathogen cues; Studies 2 and 3 used a questions-as-treatment procedure to evoke imagined contact with an infectious individual. In Study 5 we attempted a close replication of the guided-recall procedure used by Murray and Schaller (2012), but—unfortunately—found that we were not able to obtain the desired specific manipulation of pathogen avoidance

motivations. Importantly, manipulation checks suggested that the manipulations in Studies 1, 2, 3, 4, and 6 were large enough that an effect on conformity could have been observed.

Previous experiments used various measures of conformity, including measures of ethnocentrism (Navarrete & Fessler, 2006), attitudes towards art paintings (Wu & Chang, 2012), self-reported conformist attitudes (Wu & Chang, 2012; Murray & Schaller, 2012), and perceived severity of infection-relevant normative transgressions (Murray & Schaller, 2012). The current studies included similar measures of conformity.

Based on these considerations, we believe that the current findings provide no evidence that momentarily increasing pathogen avoidance motivations, for example with a disgust induction, has an immediate effect on conformity. We conclude that the current findings do not support the notion that the behavioral immune system has design features that upregulate conformity when perceiving pathogen cues (Murray & Schaller, 2012; 2016; Navarrete & Fessler, 2006; Wu & Chang, 2012). In other words, the current studies provided no evidence for a facultative or perceptual mechanism that increases conformity to ingroup norms contingent on moment-to-moment fluctuations in pathogen avoidance motivations.

In contrast, the current studies did reliably show an association between pathogen disgust sensitivity and conformity. This association is consistent with previous research that showed associations between pathogen disgust sensitivity and traits related to conformity, such as traditionalism (Tybur et al., 2016), openness to experience (Tybur & De Vries, 2013), and social conservatism (Terrizzi et al., 2013). Some research has assumed that states (e.g., feeling pathogen disgust) and conceptually related traits (e.g., being highly pathogen disgust sensitive) have similar relations with outcome variables⁵ (e.g., Horberg et al., 2009; Landy & Goodwin, 2015; Makhanova et al., 2019; Maner et al., 2005; Navarrete & Fessler, 2006; Park

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⁵ For example, Maner et al. (2005) wrote: “In addition to examining the hypothesized effects of experimental manipulation, both studies used additional methods to assess conceptually relevant individual differences...From a functionalist perspective, chronically and acutely activated motives should operate in a parallel fashion, both eliciting cognitive biases that could serve to facilitate goal-consistent responses” (p. 66).

et al., 2007). To explore this, we examined the correlations between self-reports of state-disgust that served as manipulation checks and conformity in Studies 1, 4 and 6. State disgust was not significantly correlated with conformity, Study 1: $r = .09$, $p = .179$, Study 4: $r = .02$, $p = .721$, Study 6: $r = -.02$, $p = .518$. Based on the current findings, it seems that the relation between pathogen avoidance and conformity is a case where there is a dissociation between effects observed for experimental manipulations (no strong evidence for a relation) and patterns of individual differences (strong evidence for a relation).

The current studies do not allow us to pinpoint why there is this discrepancy between effects for state and trait disgust. It is possible that the relation between pathogen avoidance and conformity observed in individual difference studies reflects a common-method bias, the influence of a confounding variable, or a reversed causal path. It is also possible that the relation between pathogen avoidance and conformity is consistent with a developmental process, so that individuals who invest more in pathogen avoidance also develop stronger conformist traits (e.g., Murray et al., 2011; Tybur et al., 2016). A starting point for investigating these developmental processes is work that has examined why people differ in their investment in pathogen avoidance (i.e., why individuals differ in pathogen disgust sensitivity; Tybur et al., 2017). One proposal is that pathogen disgust sensitivity derives from a more general predisposition toward risk-taking (Sparks et al., 2018). As assumed by the protective norms account, deviating from norms is often risky, so general predispositions for risk taking may influence pathogen disgust sensitivity and, in turn, conformity. (It is also possible that risk taking serves as a third variable influencing both disgust sensitivity and risk taking.) However, some evidence speaks against this proposal. Neuroticism (a broad personality dimension including traits associated with risk avoidance such as fearfulness and anxiety) relates only weakly with disgust sensitivity (Tybur et al., 2017). An alternative developmental explanation proposes that the relation between pathogen avoidance

motivations and social conservatism is mediated by sexual strategies; this proposal is a matter of ongoing research (see Billingsley et al., 2018; Tybur et al., 2015; O'Shea et al., 2019; Aarøe et al., 2020). Further research is required to understand the relation between pathogen disgust sensitivity and conformity. Longitudinal studies that assess whether changes in conformity follow or precede changes in disgust sensitivity might be a fruitful starting point.

Limitations

The current studies had limitations that should be taken into account when interpreting the results. First, as mentioned above across the current studies we used different manipulations of pathogen avoidance motivations. These manipulations resembled those in prior work. However, while prior work has used a variety of manipulations, it is not well understood what kind of procedures or stimuli are best for manipulating pathogen avoidance motivations (Tybur et al., 2014). For example, it is uncertain if tests of hypotheses about the effects of pathogen avoidance motivations are best tested with manipulations that induce high levels of pathogen disgust by presenting visual images (Culpepper et al., 2018), by exposure to disgusting smell (Landy & Goodwin, 2015), or with questions-as-treatment designs (Murray & Schaller, 2012). It is possible that what constitutes an ideal manipulation of pathogen avoidance motivations depends on the outcome variable, for example, with some outcomes being sensitive only to manipulations of affect (i.e., the subjective experience of feeling disgusted) and others being sensitive only to manipulations of cognitive components (e.g., worries about infection risk; for discussion see Schaller, 2014). Validated manipulations of pathogen avoidance motivations and theoretical specification of when to use what kind of manipulations would be valuable for future work investigating the workings of the behavioral immune system and its influence on cognition and behavior.

Second, the current studies used several measures of conformity similar to those used in previous research, but these were not “gold standard” measures of behavioral conformity.

Based on previous research on the link between pathogen avoidance and conformity, there seems no consensus on what operationalization of conformity (e.g., behavioral conformity, conformist attitudes, self-reported conformist behaviors) would most likely be influenced by pathogen avoidance motivations. In Study 4 we included a measure of conformity that was designed to measure conformity in a situation that involved infection risk. As a reviewer pointed out, the inclusion of pathogen cues in the measure might have washed away any effect of the pathogen avoidance manipulation, as all participants—also those in the control condition—were shown salient pathogen cues. This means that the absence of a significant effect for the secondary DV in Study 4 should be interpreted carefully. More broadly, this suggests that it might be difficult to test whether the effects of pathogen avoidance motivations on conformity are domain-specific, in the sense of occurring especially in contexts with salient infection risk. The most commonly used measure of behavioral conformity is probably Asch's (1955) line-judgment paradigm. We are not aware of any line-judgment studies that also involved a disgust induction. Further research might explore such behavioral measures, though it might be challenging to combine this method with the sample size required to detect small effects. Future studies could also focus on developing a valid measure of conformity, which is currently lacking. When examining the different measures used here and in previous work, it is unclear to what extent different measures reflect the same underlying conformist tendency (e.g., to what extent are self-reported conformist behaviors and conformist behaviors in lab paradigms correlated) and to what extent conformist behaviors in different domains converge (e.g., art judgments vs. loyalty in intergroup conflict). Validated measures of conformity suitable for laboratory and online studies would be valuable, not only for future work examining the link with pathogen avoidance motivations.

Third, Studies 1 and 2 were designed to test specific hypotheses that differentiate between the social support and protective norms accounts. These hypotheses required testing for three-way interactions and in hindsight these studies were severely underpowered to test these hypotheses. Hence, based on the current findings we cannot draw any conclusions with respect to these specific hypotheses. Because the power for tests of interactions is dependent on the effect size for the main effect (Blake & Gangestad, 2020), and the current studies suggest that the main effect is at best small, future work aimed at differentiating between the social support and protective norms account would benefit from pursuing a different strategy.

Fourth, the current studies are mute on whether the previously observed cross-cultural associations between pathogen prevalence and conformity are genuine or confounded/spurious (e.g., Bromham et al., 2017; Hruschka & Hackman, 2014). The current studies did not examine cross-cultural differences; they only tested one candidate explanation for such cross-cultural differences.

Implications

The current findings do not support the notion that the behavioral immune system has design features that immediately upregulate conformity contingent on salient pathogen cues. The implication is that there is currently little evidence in support of such a fast-acting mechanism underlying cross-cultural associations between infectious disease and tight norms (cf. Murray et al., 2011). It is possible that the observed cross-cultural associations between infectious disease and tight norms would require only very small effects of pathogen cues on conformity. Further research of this cross-cultural association might aim for (1) developing precise proposals about the required magnitude of the effect of pathogen cues on conformity, (2) testing for a fast-acting mechanism that produces an effect of the required magnitude, or (3) alternatively, develop and test explanations in terms of other processes and psychological

mechanisms, such as developmental processes, relational mobility, or cultural evolution (e.g., Tybur et al., 2016; Conway et al., 2020).

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