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In-group binding moral values and reactive behavioral immune responses

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Abstract

Previous studies on psychological adaptations to pathogen threats revealed the link between pathogen psychology and group behavior, especially in-group-oriented mindsets such as conformity, and the endorsement of group binding moral values. The relationship between behavioral immune responses and in-group attitudes has been mostly discussed in relation to the adaptive strategy to avoid pathogens. Yet, there is the other side of the behavioral immune system: reactive defense against pathogens (e.g., soliciting social support from others). By operationally defining in-group-oriented mindsets as the endorsement of group binding moral values, we explored how the tendencies to avoid diseases and minimize the negative influences of contracted diseases were each related to in-group-oriented mindsets in two countries (Study 1: the UK, $N = 645$; Study 2: Japan, $N = 651$). We found that the endorsement of group binding moral values was robustly associated with the latter but not with the former, suggesting that the reactive side of pathogen psychology may play an important role in shaping in-group-oriented mindsets.

Keywords Behavioral immune system · Morality · In-group · Pathogen avoidance · Moral foundation theory

The COVID-19 pandemic was a fresh reminder of the threat of infectious diseases, as the virus continues to infect people daily and has killed over six million individuals worldwide. This is just one recent example of pathogen threats and humans have constantly faced threats posed by infectious diseases and parasites throughout human evolution. As such, pathogen threats have acted as a strong selection pressure and humans correspondingly have developed psychological immune systems to deal with them (Schaller, 2006, 2011). The rich body of research on psychological adaptations to pathogen threats has revealed that pathogen psychology is closely linked not only to disease avoidance behavior, but also to a wide range of social psychological phenomena such as prejudice and intergroup attitudes (e.g., Ackerman et al., 2021).

Schaller argues that humans have acquired the behavioral immune system (Schaller, 2006, 2011) as adaptations to pathogen threat. The behavioral immune system detects and responds to pathogen threats, and it promotes behaviors that serve to protect people from infectious diseases. The system follows the smoke detection principle and, thus, often responds to pathogen-irrelevant stimuli such as obesity (e.g., Park et al., 2007) and physical and psychological disabilities (e.g., Park et al., 2003).

Of particular importance to our research is the proposition that the behavioral immune system has shaped in-group-oriented mindsets (Fincher & Thornhill, 2012; Imada & Mifune, 2021). Fincher and Thornhill (2012) argued that pathogen threats encouraged people to form a supportive network in which they can help each other to cope with infectious diseases. This suggests that orientations towards collectivism as well as group binding values (e.g., group loyalty) can be adaptive, as they help people establish a cohesive group in which norms to coop with pathogens can be easily implemented and regulated. Consistently with this, historical pathogen prevalence is positively correlated with collectivism (Fincher et al., 2008; Thornhill et al., 2010) and

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traditionalism (Tybur et al., 2016), and is negatively correlated with individualism (Fincher et al., 2008; Thornhill et al., 2010). Psychological work also revealed that pathogen concern was associated with conservatism (Park & Isherwood, 2011), increased attraction to in-group members (Navarrete & Fessler, 2006), and conformity (B. P. Wu & Chang, 2012). More importantly, nation- and individual-level analyses collated converging evidence that pathogen prevalence and pathogen concern are positively associated with the endorsement of group binding moral values (Atari et al., 2022; Makhanova et al., 2019; Van Leeuwen et al., 2012). These findings support the claim that pathogen psychology is tied to in-group-oriented minds.

However, this view has received criticism; previous studies suggested that in-group members can be a primary sources of infection and individuals would thus avoid in-group members under pathogen threats (Wu et al., 2015, 2019). Similarly, van Leeuwen and Petersen (2018) demonstrated that people avoid others with pathogen cues regardless of their group membership, suggesting that the behavioral immune system promotes behavioral avoidance even towards in-group members (but also see Bressan, 2021). These studies suggest that pathogen threats have not simply fostered in-group-oriented mindsets and behaviors (also see Hruschka & Henrich, 2013).

To disentangle the seemingly mixed literature, Imada and Mifune (2021) contended that in-group-oriented minds serve as a reactive, rather than proactive defense system against pathogens. While proactive defense aims to avoid contracting diseases, reactive defense minimizes the negative influence of infectious diseases, for instance, by eliciting social support from others. They further argued that in-group-oriented behavior (i.e., cooperation and helping, which often involve physical contacts) may be thus prompted when individuals feel sick or suspect that they have contracted a virus. Contrastingly, when people are exposed to pathogen threats in a way that they fear contracting diseases, the behavioral immune system promotes behavioral avoidance even towards in-group members. In other words, based on their argument, in-group-oriented mindsets would be associated with the tendency to minimize the influence of diseases rather than the tendency to avoid contracting them. Nevertheless, there have not been any studies directly testing their claims.

Therefore, in this research, testing the claim by Imada and Mifune (2021), we aimed to explore the relationship between in-group-oriented minds, the tendency to avoid contracting diseases, and the tendency to swiftly react when one has contracted diseases. To this end, we based our study on findings by Makhanova et al. (2019) as a benchmark and used the moral foundations as an index of the endorsement of group binding values (i.e., in-group-oriented minds). In addition, we used germ aversion from the perceived vulnerability to disease scale as an index of the tendency to avoid diseases.

As previous research on the behavioral immune system predominantly focused on proactive defense behavior such as germ aversion and the reactive immune behaviors have been rarely studied (for reviews, see Schrock et al., 2020; Shakhar, 2019), there are no well-established measurements of the reactive behavioral immune tendencies. As such, we developed a new scale to measure the reactiveness to pathogens with the expectation that there is a positive correlation between the tendency to swiftly behave to minimize the influence of disease infections and the strength of the in-group-oriented mindset. We tested this in two distinct populations to ensure the generalizability of our findings: students in the UK (Study 1) and Japanese adults (Study 2).

Study materials, data, analysis code, and supplementary results are available at https://osf.io/293t5/?view_only=fa5b651de57a4ea8a9329e0ffeaf107d. In addition, we took an opportunity to directly replicate the benchmark findings by Makhanova et al. (2019) on the relationship between the endorsement of binding and individualizing moral values and perceived vulnerability to disease (germ aversion and perceived infectability). We report the results of direct replication in supplementary results in the OSF page.

Method

Participants and procedure

In Study 1, in order to maximize the sample size, we advertised the study in a large university student participant pool and had it open for participation for one semester (September 2021 to December 2021). After closing the recruitment, we had 645 students (101 males, 537 females, $M_{age} = 19.60$, $SD = 3.57$) from a British University, which exceeded the recommended minimal sample size of 250 for correlational research (Schönbrodt & Perugini, 2013). In Study 2, we recruited 651 Japanese participants (344 males, 303 females, $M_{age} = 41.28$, $SD = 10.32$) from an online crowdsourcing platform and the target sample size was determined based on our budgetary limit.

After giving consent, participants are presented with items measuring reactiveness to pathogens, pathogen disgust (Tybur et al., 2009), perceived vulnerability to diseases (Duncan et al., 2009), and moral foundations (Graham et al., 2011). In addition, we measured ethnocentrism (Neuliep, 2002) and attitudes towards immigrants for an exploratory purpose, in Study 1 and Study 2, respectively. Participants then provided demographic information sex, age, and nationality) and were dismissed.

Measures

Reactiveness to pathogens We developed twelve items to measure reactiveness to pathogens. More specifically, we prepared eight items designed to measure action tendency of people who think they have got sick (e.g., "When I feel unwell, I go see a doctor as soon as possible."). The other four items were created to measure how prepared individuals are to react to diseases that they have caught (e.g., "I always carry medicine with me."). All items were measured with a 7-point Likert scale ranging from *1 = strongly disagree* and *7 = strongly agree*.

Pathogen disgust To measure pathogen disgust sensitivity, we used the subscale of the three-domain disgust scale (Tybur et al., 2009). Participants were presented with seven items and asked to indicate how disgusting they found them (e.g., "sitting next to someone who has red sores on their arm.", $\alpha = 0.71$), using a scale ranging from *0 = not at all disgusting* to *6 = extremely disgusting*. We re-corded them such that responses range from 1 to 7.

Perceived vulnerability to diseases We introduced the perceived vulnerability to diseases, which consists of 15 items. Seven items measure perceived infectability (e.g., "In general, I am very susceptible to colds, flu, and other infectious diseases.", $\alpha = 0.87$) and eight items measured germ aversion (e.g., "I prefer to wash my hands pretty soon after shaking someone's hand", $\alpha = 0.71$). We further built a structural equation model in which we treat perceived infectability and germ aversion as latent variables and they further load onto a single latent variable, sensitivity of proactive behavioral immune system (PBIS).

Moral foundation questionnaire Following Makhanova et al. (2019), we used the 30 item moral foundation questionnaire (Graham et al., 2011) to measure the endorsement of group binding and individualizing moral values. The questionnaire consists of two subsets, and participants are asked to indicate how relevant presented statements are to their thinking when they decide whether something is right or wrong (e.g., "whether or not someone was denied his or her rights."), using a 6-point scale from *0 = not at all relevant* to *6 = extremely relevant*. The second set asked participants to indicate to what extent they agreed with presented statements (e.g., "people should not do things that are disgusting, even if no one is harmed."), using a 6-point scale from *0 = strongly disagree* to *5 = strongly agree*. We re-corded them such that responses range from 1 to 6. We then computed scores for harm, fairness, loyalty, authority, and sanctity, by taking sums of corresponding items. In addition, following Makhanova et al. (2019) we computed indices of the endorsement of group binding moral values (sanctity, authority, and loyalty: $\alpha = 0.82$) and individualizing moral values (care and fairness: $\alpha = 0.78$). For Study 2, we back-translated study materials in English into Japanese.

Table 1 Results from the one-factor model exploratory factor analysis

Item		Loading	
		Study 1	Study 2
at1	When I feel unwell, I take medicine as soon as possible.	0.57	0.64
at2	When I feel unwell, I go see a doctor as soon as possible.	0.61	0.51
at3	When I feel there is something wrong with my health, I look up my condition on the Internet or in books.	0.31	-
at4	When I am not feeling well, I get anxious.	0.52	0.46
at5.r	I am indifferent to my health.	0.04	-
at6	When I get sick, I am motivated to change my lifestyle.	0.42	0.31
at7	When I feel a little sick, I want to take the day off school or work.	0.28	-
at8.r	I do not care if I am a little sick.	0.33	0.42
p1	When I travel, I take medicine with me.	0.51	0.78
p1	I always carry medicine with me.	0.55	0.77
p3	I try to acquire knowledge about symptoms of diseases and epidemics and their treatments.	0.40	0.45
p4	Before I travel, I look up the location of medical facilities in my destination.	0.45	0.39

at action tendency; *p* preparedness. Based on the factor loading, items, at3, at5.r, and at7 were dropped in Study 1. In Study 2, these items were not included in the first place

Results

Reactiveness to pathogens

Using data from Study 1, we explored the factor structure of the items designed to measure reactiveness to pathogens, we conducted exploratory factor analyses with unweighted least square extraction and Promax rotation (KMO = 0.76). Since we expected to observe two factors (action tendency and preparedness), we first applied a two-factor model to the data and conducted an exploratory factor analysis with Promax rotation. However, based on the scree plot and the eigenvalue explained by the second factor (see online supplementary material), we decided to opt for a one-factor model. We omitted three items whose factor loadings were below 0.32 (Tabachnick & Fidell, 2007) and we computed a factor score as an index of the reactiveness to pathogens for subsequent analyses. We conducted the same analyses using data from Study 2 (KMO = 0.76) and found the same single-factor structure. Table 1 summarizes factor loadings from

the one-factor model. The reliability of the scale was satisfactory in both studies, Study 1: $\alpha = 0.73$, Study 2: $\alpha = 0.79$.

To test the construct validity of the newly developed scale to measure reactiveness to pathogens, we investigated if the scale score was correlated with theoretically relevant psychological constructs such as germ aversion, perceived infectability, and pathogen disgust sensitivity. In Study 1, reactiveness to pathogens was significantly correlated with them: germ aversion: $r = .27$, $p < .001$; perceived infectability: $r = .26$, $p < .001$; pathogen disgust sensitivity: $r = .17$, $p < .001$. In Study 2, reactiveness to pathogens was also significantly correlated with them: germ aversion: $r = .25$, $p < .001$; perceived infectability: $r = .40$, $p < .001$; pathogen disgust sensitivity: $r = .19$, $p < .001$.

We then checked measurement invariance between the English (Study 1) and Japanese (Study 2) versions. To this end, we constructed a baseline model in which the nine items measuring reactiveness to pathogens loaded on the single latent factor and all parameters were same across the two languages. Overall model fit was not satisfactory (CFI = 0.76, RMSEA = 0.13, SRMR = 0.07) and we added 12 item covariances to the baseline model based on modification indices. The updated model showed satisfactory fit, CFI = 0.98, RMSEA = 0.05, SRMR = 0.03. We then built the metric invariance and scaler invariance models and examined changes in goodness-of-fit indices (Table 2). Based on Chen' (2007) criteria (invariance threshold of $\Delta CFI \leqq 0.01$, $\Delta RMSEA \leqq 0.015$, $\Delta SRMR \leqq 0.01$), there was weak evidence for metric invariance and scaler invariance was not observed. To establish partial scaler invariance, we released one parameter estimate such that it was freely estimated for the two languages. This partial scaler invariance model did not substantially lower the goodness-of-fit indices and we computed latent factor scores based on this model.

Table 2 Comparisons of goodness-of-fit indices

	ΔCFI	ΔRMSEA	ΔSRMR
Metric vs. Baseline	−0.014	0.007	0.02
Scaler vs. Metric	−0.109	0.05	0.03
Part Scaler vs. Metric	−0.03	0.01	0.007

Reactiveness to pathogens, germ aversion, and morality

Using the laten factor score of reactiveness to pathogens, we examined how reactiveness to pathogens and germ aversion independently predicted the endorsement of different moral values, controlling for participants' age and sex (male = 0; female = 1). Table 3 summarizes results of the multiple regression analyses. Across the two populations, we found that reactiveness to pathogens was positively associated with the endorsement of binding moral values. In other words, the more reactive people were to pathogens, the more strongly they endorsed the binding moral values, supporting our prediction. In contrast, it was not significantly related to the endorsement of individualizing moral values.

Consistently with Makhanova et al. (2019), we found that germ aversion was positively associated with the endorsement of binding moral values while it was not significantly related to that of individualizing moral values in the UK. However, among Japanese, germ aversion was not significantly associated with the endorsement of binding moral values.

In online supplementary results, we report regression analyses in which we controlled for perceived infectability, pathogen disgust, age, and sex. Overall, the inclusion of the covariates did not alter the relationship between reactiveness pathogens and the endorsement of moral values, suggesting that the relationship is robust. In addition, we took

Table 3 Results from the multiple regression analyses predicting the endorsements of different moral values

DV		RtP		GA		Age		Sex	
		β	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Binding	UK	0.15	< 0.001	0.19	< 0.001	0.03	0.40	−0.04	0.27
	Japan	0.12	< 0.001	0.07	0.07	0.03	0.40	0.04	0.35
Sanctity	UK	0.09	0.03	0.25	< 0.001	0.29	0.45	0.02	0.59
	Japan	0.11	< 0.001	0.13	< 0.001	0.06	0.10	−0.06	0.11
Authority	UK	0.14	< 0.001	0.15	< 0.001	0.03	0.41	−0.05	0.18
	Japan	0.11	< 0.001	0.05	0.19	−0.01	0.86	0.09	0.04
Loyalty	UK	0.17	< 0.001	0.09	0.03	0.02	0.58	−0.08	0.03
	Japan	0.09	0.03	0.005	0.90	0.02	0.57	0.07	0.09
Individualizing	UK	0.05	0.20	0.07	0.10	0.03	0.47	0.17	< 0.001
	Japan	0.07	0.08	0.07	0.08	0.07	0.06	−0.06	0.17
Care	UK	0.06	0.11	0.05	0.20	0.05	0.17	0.21	< 0.001
	Japan	0.05	0.24	0.07	0.09	0.09	0.03	−0.13	< 0.001
Fairness	UK	0.03	0.45	0.07	0.08	−0.003	0.95	0.10	0.01
	Japan	0.08	0.05	0.06	0.15	0.05	0.22	0.03	0.48

RtP Reactiveness to Pathogens, *GA* Germ Aversion, *Sex* 0 = men: 1 = women

an opportunity to directly replicate the relationship between germ aversion, perceived infectability, and the endorsement of different moral values reported in Makhanova et al. (2019) with a larger sample size. We report the results of the direct replication in online supplementary material on the OSF page.

General discussion

We aimed to test the hypothesis that the endorsement of in-group binding moral values would be more strongly associated with the reactiveness to pathogens than germ aversion. We had three domains of group binding moral values: sanctity, authority, and loyalty. In line with the hypothesis, reactiveness to pathogens was robustly associated with the endorsement of binding moral values across two cultures. However, germ aversion, the indicator of proactive behavioral immune tendencies, was not. More specifically, germ aversion predicted the endorsement of bonding moral values when reactiveness to pathogens was controlled in the UK, but it did not in Japan.

Imada and Mifune (2021) argued that reactive defense responses such as in-group-oriented minds can be an adaptive strategy to solicit social support. Previous studies on reciprocity suggested that cooperation, costly acts to benefits others, is particularly effective in soliciting cooperation and helping (i.e., reciprocity) from others in diverse exchange relations (Melamed et al., 2020; Rumble et al., 2022). Thus, assuming that the reactiveness to pathogens is in fact adaptation to evolutionary challenges to coalitions and secure social support, in-group cooperation, rather than the endorsement of in-group-oriented values, would be a stronger correlate of the reactive behavioral immune system. Thus, it is sensible to further explore the relationship between reactiveness to pathogens and diverse in-group-oriented behaviors. In light of recent findings that the behavioral immune system may not refer to group membership per se (Fan et al., 2022; Makhanova et al., 2022), further research on the reactive, rather than proactive, behavioral immune responses may help us elucidate how pathogen psychology shapes intergroup group behavior.

Unexpectedly, we found that while germ aversion predicted the endorsement of group binding moral values in the UK, it did not in Japan. Recently, Atari et al. (2023) developed a new measurement of moral foundation and suggested that the individualizing-binding dichotomy is culture-dependent. More specifically, they conducted nomological network analyses of moral foundations and revealed that while data from American participants indicated a two-dimensional structure, that from Japan indicated a unidimensional structure. In other words, they suggest that among Japanese, there may not be a clear-cut difference between individualizing and binding moral values. As such, the observed cultural difference in our study may be to some extent attributed to the cultural difference in the conceptualization of moral values and structures underlying different moral foundations.

Finally, we would like to point out that the measurement of the reactiveness to pathogens can be further refined and adjusted to different cultural contexts. In our items, we attempted to measure the action tendency when one feels unwell, and we did not explicitly state that the unwellness stemmed from infectious diseases. As such, some participants might think of lifestyle, non-communicable diseases such as cancers and heart diseases or mental illness, and the observed strength of the relationship between reactiveness to pathogens and in-group-oriented mindset might thus be underestimated. In addition, we used the term “doctor” and “medical facilities” in our items. For those who cannot afford to see doctors and visit the facilities, these items may fail to capture the reactiveness to diseases. The present study was conducted in the United Kingdom, where there is a universal health insurance system, and these items would be suitable. However, these need be dropped or replaced when applied to contexts in which some people do not have access to health care systems. Overall, the observed relationship between reactiveness to pathogens and the endorsement of group binding mora values may be underestimated in the present research. It is thus sensible for future work towards establishing a refined measurement of the scale, in order to better elucidate the relationship between in-group-oriented mindsets and behavioral immune system.

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Data availability The datasets generated during and analysed for the reported studies are available at https://osf.io/293t5/?view_only=ffd0fcd3b10a48b5b1cfbc581b9efc90.

Declarations

Ethics statement Our data has never been presented anywhere and the study was conducted in accordance with the ethics guidelines set out in the BPS Code of Ethics and Conduct (2018) and [Deducted for blind peer review] Code of Ethical Practice for Research.

Conflict of interest Authors have no conflicts of interest to declare.

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