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Can a Naturally Occurring Pathogen Threat Change Social Attitudes? Evaluations of Gay Men and Lesbians During the 2014 Ebola Epidemic

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Abstract

Previous evidence linking disease threat and social attitudes suggests that a highly salient society-wide pathogen threat should lead to more negative attitudes toward gay men and lesbians. Using a sample of 248,922 Americans recruited via the Project Implicit website, we tested whether implicit attitudes toward gay men and lesbians shifted as a result of the 2014 Ebola virus outbreak. Regression discontinuity analyses, but not *t*-tests, showed evidence of a small shift in implicit (but not explicit) attitudes at the height of public concern over Ebola. These results could be interpreted as providing partial support for the effects of naturally occurring pathogen threats on social attitudes. Alternatively, given the large size of our sample, the mixed evidence and small effects may reflect a boundary condition for the operation of the behavioral immune system.

Keywords

attitudes, automatic/implicit processes, evolutionary psychology, political psychology, prejudice/stereotyping

Introduction

Pathogens and parasites have been a significant survival threat throughout human history (Curtis, de Barra, & Aunger, 2011). To protect against this threat, humans have a physiological immune system as well as an array of culturally and biologically evolved behavioral adaptations which are often referred to as the "behavioral immune system" (BIS; Faulkner, Schaller, Park, & Duncan, 2004; Park, Faulkner, & Schaller, 2003; Schaller & Duncan, 2007). The BIS is thought to include social and political attitudes such as hostility toward foreign groups, especially unfamiliar ones (Faulkner et al., 2004; Navarrete, Fessler, & Eng, 2007), adherence to cultural traditions (Murray, Trudeau, & Schaller, 2011), and sexual restrictiveness (Tybur, Inbar, Molho, Güler, 2015). Collectively, these can mitigate an array of pathogen risks. Hostility toward unfamiliar groups may reduce pathogen risks associated with intergroup contact (see Thornhill & Fincher, 2014); adherence to cultural traditions and rituals (especially those related to hygiene or food preparation) may neutralize ecologically specific pathogens and parasites (Murray et al., 2011); and sexual restrictiveness reduces the risk of pathogen exposure posed by new sexual partners (Schaller & Murray, 2008).

Of course, more pathogen-avoidant behaviors in these domains can also have fitness costs—forgone opportunities for trade and cultural exchange, rejection of useful innovations, and missed mating opportunities. The optimal level of pathogen avoidance therefore balances the risks of potential pathogen exposure with the costs of forgoing these potential benefits. This suggests that just as the physical immune system responds flexibly to pathogen cues in the environment (Schaller et al., 2010), the BIS should be expected to become more active in response to temporary or chronic pathogen threat. Indeed, temporarily increasing the salience of pathogen threats decreases warmth toward sexual out-groups (i.e., gay men and lesbians; see Inbar & Pizarro, 2014, for a review). Likewise, people from geographical regions with historically higher pathogen prevalence (i.e., with elevated pathogen risk) tend to be more sexually conservative and culturally traditional (Schaller & Murray, 2008; see also Fincher & Thornhill, 2012). In the current study, we build on this research to examine changes in Americans' social attitudes in response to a naturally occurring pathogen threat: the West African Ebola virus epidemic.

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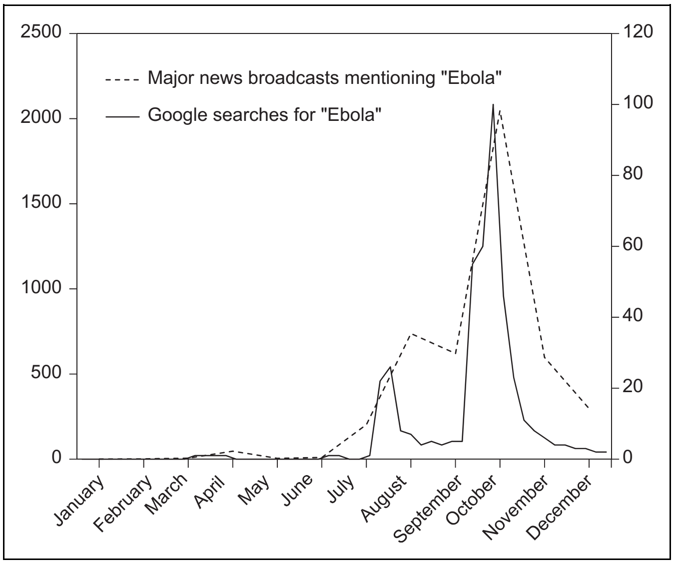

Figure 1. Major news broadcasts mentioning "Ebola" (counts for each month, left y-axis) and Google search frequency for Ebola (normalized for overall search volume, right y-axis) in 2014 in the United States. Google search data available from http://www.google.com/trends/explore?hl=en-US&q=ebola&geo=US&date=1/2014+12m. News broadcast data retrieved from LexisNexis on October 9, 2015.

The Ebola Virus Epidemic

The World Health Organization declared the West African Ebola virus outbreak a "public health emergency of international concern" on August 8, 2014 (World Health Organization, 2014). Although nearly all confirmed cases were in Guinea, Liberia, and Sierra Leone (Centers for Disease Control and Prevention, 2015), in the fall of 2014 there was widespread concern in the United States that Ebola might spread domestically. The first Ebola case in the United States was diagnosed on October 1 and was covered extensively in the U.S. print and broadcast media. According to a LexisNexis search of major U.S. broadcast news networks, Ebola was mentioned 2,048 times during October 2014—compared to 621 times in September, 738 times in August, and 274 times in January and July combined (see Figure 1). Likewise, a Dow Jones Factiva search of U.S. news and business publications retrieved 13,742 articles mentioning Ebola in October 2014, nearly twice as many as in January and September combined (7,044).[1] This intense media coverage produced widespread popular concern about Ebola, which peaked in October 2014. An analysis of Google searches shows that the Americans searched for "Ebola" more than 10 times as frequently in October 2014 than in the previous 8 weeks (see Figure 1).[2] If there were to be an Ebola-related shift in social attitudes, it should be most evident in October, when public concern with the disease peaked in the United States.

Pathogen Threat and Attitudes Toward Gay Men and Lesbians

Sexual conservatism (i.e., restrictiveness) is thought to be an important component of the BIS (Tybur et al., 2015). In fact, the relationship between pathogen threat and more negative attitudes toward gay men and lesbians is one of the most robust findings in the BIS literature. Higher dispositional pathogen sensitivity is associated with more negative attitudes toward gay people in diverse samples (e.g., Hodson & Costello, 2007; Inbar, Pizarro, Knobe, & Bloom, 2009; Olatunji, 2008; Terrizzi, Shook, & Ventis, 2010). Consistent with BIS theory, this association seems to be statistically explained by greater overall sexual restrictiveness among the pathogen sensitive (Crawford, Inbar, & Maloney, 2014; Olatunji, 2008; Tybur et al., 2015). Likewise, exposing people to pathogen threats makes them harsher toward gay people. Undergraduates who saw images priming pathogen threats (e.g., a cockroach on food) subsequently showed more implicit negativity toward gay people (Dasgupta, DeSteno, Williams, & Hunsinger, 2009), and those who were exposed to a disgusting odor were more explicitly negative toward gay men, but not toward other social groups (e.g., African Americans or the elderly; Inbar, Pizarro, & Bloom, 2012).

BIS theory would therefore predict that a highly salient society-wide pathogen threat—such as the 2014 Ebola outbreak—should lead to more negative attitudes toward gay men and lesbians during the time that the threat is most salient. In the current research, we used a large, diverse sample of Americans to test this prediction. In a sample of over 200,000 Americans recruited via the Project Implicit website (http://www.projectimplicit.net), we examined whether attitudes toward gay people became more negative during October 2014, the high point of public concern over Ebola.

Our primary analyses focused on implicit attitudes toward gay people, as assessed by a gay-straight Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998; Nosek, Greenwald, & Banaji, 2007). The IAT measures the relative associative strength between concepts (e.g., straight and gay people) and attributes (e.g., good and bad). To the extent that a participant is quicker to pair gay with "bad" and straight with "good," he or she can be said to have a negative implicit association with gay people as compared to straight people. The IAT has been employed to assess implicit positive and negative associations with a large variety of concepts and groups, including gay people (Banse, Seise, & Zerbes, 2001; Gabriel, Banse, & Hug, 2007). We focused on IAT scores because they are malleable (Lai et al., 2014) but less controllable than more overt measures, such as Likert-type scales (Banse et al., 2001; Kim, 2003; Nosek, Greenwald et al., 2007; although see Fiedler & Bluemke, 2005). As Americans' attitudes toward gay men and lesbians have grown steadily more positive (Westgate, Riskind, & Nosek, 2015), people may be more reluctant to express negative attitudes toward them, and implicit measures like the IAT have the advantage of being less affected by social desirability or self-presentation motives.

A shift in implicit attitudes toward gay people during the Ebola epidemic would thus provide strong evidence for a connection between pathogen threat and social attitudes and demonstrate a meaningful consequence of this link for public opinion. The *absence* of a shift could establish an important boundary condition on the effects of pathogen threat on social attitudes. It might also suggest that the theory linking pathogen threats and social attitudes requires revision.

Method

We report how we determined our sample size, all data exclusions, and all measures analyzed. Additional measures are available online at https://osf.io/nrfdt and https://osf.io/ctqxo. Before conducting any analyses, we preregistered our analysis plan at https://osf.io/zbigf; any deviations from this plan are noted.

Participants were volunteers who chose to complete the "sexuality" IAT on the Project Implicit website (https://implicit.harvard.edu) between January 1, 2010, and October 31, 2014. Participants completed the IAT, explicit measures, and demographics in random order. All received feedback on their IAT scores at the conclusion of the session.

We included only participants who were 18 years or older ($M = 26.7$ years, $SD = 10.3$), identified as heterosexual, and were current U.S. residents. Of this group, we excluded 8,274 participants (3.2%) who had incomplete data for key measures and 7,903 participants (3.1%) who had at least one of (a) an overall error rate of greater than 30%, (b) error rates above 40% on any individual block, or (c) a latency of 400 ms or less on more than 10% of IAT trials (Greenwald, Nosek, & Banaji, 2003; Nosek, Smyth et al., 2007). The final data set consisted of 248,922 participants, with a mean of 151.41 ($SD = 91.56$; median = 128) participants per day.

Among those reporting demographics, 68.7% of participants were female, 71.1% White (not of Hispanic origin), 9.5% Black (not of Hispanic origin), 9.2% Hispanic, 4.6% multiracial (Other), 2.6% Asian or Pacific Islander, 1.1% multiracial (Black and White), 0.5% American Indian or Alaskan Native, and 1.3% "Other" or "don't know." Participants were highly educated; 89.4% reported some college or an undergraduate college degree, 11.4% were completing or had completed an advanced degree, and 10.6% reported a high school education or less. Politically, 41.9% of participants identified as liberal, 23.0% as conservative, and 35.2% as moderate.

Implicit and Explicit Preferences for Straight Over Gay People

The IAT (Greenwald et al., 1998; Nosek, Greenwald, et al., 2007) measures the associative strength between concepts (e.g., straight and gay people) and attributes (e.g., good and bad). Participants categorize target stimuli appearing one at a time on the screen. In the first critical block, *Gay people* and *Good* items are categorized with one response key, while *Straight people* and *Bad* items are categorized with the other. In the second critical block, *Gay people* and *Bad* items are categorized with one response key and *Straight people* and *Good* items with the other key. Participants who categorize items faster in the first condition compared to the second are said to have an implicit preference for gay people compared to straight people. We used the standard seven-block format (Nosek, Greenwald, & Banaji, 2005) and computed IAT scores using the *D* algorithm recommended by Greenwald, Nosek, and Banaji (2003). Higher positive values indicated a stronger implicit preference for straight people over gay people.

Explicit attitudes were measured with a 7-point Likert-type scale ranging from −3 *I strongly prefer straight people to gay people* to +3 *I strongly prefer gay people to straight people*, with the midpoint representing equal liking. Scores were reverse coded for analyses, such that higher positive values indicated a stronger preference for straight people.

Analysis Plan

In our analysis plan, we defined four separate analyses to pursue convergent evidence for the hypothesis:

1. A two-tailed *t*-test comparing mean implicit preferences in October 2014 with mean implicit preferences from January through September 2014.
2. A two-tailed *t*-test comparing mean implicit preferences in October 2014 with the mean implicit preferences of October 2010, 2011, 2012, and 2013 combined.
3. A regression discontinuity analysis[3] (Thistlethwaite & Campbell, 1960) to test for a discontinuity in implicit preferences at October 1, 2014. We planned to include data from June 1, 2014, to October 31, 2014.
4. A comparison of confidence intervals (CIs) for regression discontinuity effect size estimates for the 2014 data with the same analysis on 2013, 2012, 2011, and 2010 data.

Evidence for the hypothesis would be significant effects for (1), (2), and (3) in the direction of stronger implicit preferences for straight over gay people during the Ebola outbreak time period compared to the others, as well as, (4) a larger discontinuity effect size in 2014 than in any of the preceding years. Given the very large size of this sample and precise estimation, we planned that all four analyses needed to provide statistical support consistent with the hypothesis to be considered confirmation. Although our analysis plan focused on implicit attitudes, for completeness, we also planned to repeat these analyses with explicit attitudes as the dependent variable.

Results

Confirmatory Analyses for Implicit Preferences

Test 1. A two-tailed *t*-test comparing mean implicit preferences for straight people over gay people in October 2014 (IAT *D* score $M = .38$, $SD = .43$) versus mean implicit preference from January through September 2014 ($M = .37$, $SD = .44$) revealed no difference in IAT scores between the months, $t(41{,}121) = .63$, $p = .53$, Cohen's $d = .01$, CI [−.02, .04]. In both periods, participants showed a moderate implicit preference for straight people over gay people on average.

Table 1. Change in Preferences for Straight People Compared to Gay People in October 2010–2014 as Assessed by Separate Sets of Regression Discontinuity Models for Each Year.

	Implicit Preferences					
	4-Month model (preregistered)		3-Month model		2-Month model	
Year	*b* [95% CI]	*n*	*b* [95% CI]	*n*	*b* [95% CI]	*n*
2014	.023 [.005, .04]	18,882	.024 [.004, .045]	16,464	.024 [−.001, .05]	14,535
2013	−.014[a] [−.032, .005]	20,315	−.014[a] [−.034, .006]	17,711	−.012 [−.037, .012]	15,001
2012	.015 [−.002, .031]	22,343	.019 [.000, .038]	19,209	.006 [−.017, .029]	16,685
2011	.013 [−.011, .037]	13,252	.000 [−.027, .027]	10,520	.005 [−.029, .039]	8,527
2010	.000 [−.018, .018]	19,118	−.003 [−.023, .018]	16,711	−.012 [−.036, .013]	14,436
	Explicit Preferences					
	4-Month model (preregistered)		3-Month model		2-Month model	
	b [95% CI]	*n*	*b* [95% CI]	*n*	*b* [95% CI]	*n*
2014	0.032 [−.011, .075]	19,462	0.031 [−.017, .08]	16,963	0.022 [−.038, .083]	14,974
2013	−0.006 [−.05, .039]	20,632	−0.02 [−.07, .029]	17,972	−0.04 [−.101, .021]	15,224
2012	0.02 [−.023, .063]	22,739	0.004 [−.044, .053]	19,547	−0.003 [−.062, .056]	16,938
2011	−0.049[a] [−.113, .016]	13,323	−0.084[a] [−.156, −.012]	10,564	−0.115[a] [−.207, −.024]	8,578
2010	−0.036 [−.086, .013]	19,028	−0.037 [−.093, .019]	16,664	−0.06 [−.127, .007]	14,412

Note. Regression coefficients and 95% confidence intervals test the discontinuity in implicit association test *D* scores at October 1. CI = confidence interval.
[a]Differs from that model's estimate for 2014 at $p < .05$ (two-tailed).

Test 2. A second two-tailed *t*-test comparing the average IAT score in October 2014 ($M = .38$, $SD = .43$) with the average aggregate IAT score from October 2010, 2011, 2012, and 2013 ($M = .41$, $SD = .43$) revealed that implicit preferences for straight people over gay people were *lower* in October 2014 than in previous years, $t(26{,}483) = -5.75$, $p < .001$, Cohen's $d = -.08$, CI [−.11, −.06]. This likely reflects a broader cultural shift toward greater positivity toward gay men and lesbians over the last 5 years (Westgate et al., 2015).

Test 3. A regression discontinuity analysis comparing IAT *D* scores before and after October 1, 2014, revealed a statistically significant discontinuity in the predicted direction at October 1, $b = .023$, $t(18{,}880) = 2.54$, $p = .011$. This effect, however, was small: Implicit preferences for straight people were predicted to increase by just .02 points at the October 1 breakpoint, which corresponds to a Cohen's d of .04, CI [.01, .07].

Test 4. Discontinuities at October 1 for 2010–2013 did not significantly differ from zero (coefficients and 95% CIs for each year are shown in Table 1 in the first column). The discontinuity for October 2014 was always directionally larger than that for previous Octobers, but, with the exception of 2013, these differences were not significant (see Table 1 for details). However, when we computed a weighted combined coefficient ($b.1$) for 2010–2013 (see Becker & Wu, 2007, equation 2; Borenstein, Hedges, & Rothstein, 2007; equations 2.7 and 2.8), this value differed significantly from the 2014 coefficient; $b.1 = 0.003$, CI [−0.006, 0.012]; $b_{2014} = .023$, CI [.005, .041]; $Z_{diff} = 2.00$, $p = .045$. Thus, the estimate for 2014 differed from the 2010–2013 estimates combined.

Exploratory Analyses for Implicit Preferences

After conducting the confirmatory analyses, we examined our choices for the regression discontinuity analyses and explored some alternatives to test robustness to different choices. Regression discontinuity analysis is more sensitive when the total range of the independent variable is closer to the breakpoint, but there are no formal guidelines for choosing what the range should be. In the current case, reducing the total range of days comes with the disadvantage of reducing the total sample size (which lowers the precision of estimates). We therefore tested three models with different ranges of days. In every model, the days after the breakpoint (i.e., October 1 to October 31) were the "treatment" days, but we varied the number of "control" days. The confirmatory plan was the 4-month model. That model treated the 4 months before the breakpoint (i.e., June 1 to September 30) as the control days. For follow-up analyses, we added two more models. In the 3-month model, the control days were July 1 to September 30; and in the 2-month model, the control days were August 1 to September 30. For each of these, we repeated Tests 3 and 4 of our original confirmatory analysis plan.

Test 3. The discontinuity was significant in the predicted direction for the 3-month model, $b = .024$, $t(16{,}462) = 2.32$, $p = .021$, but not for the 2-month model, $b = .024$, $t(14{,}533) = 1.88$, $p = .06$, though it was similar in magnitude. Again, these effects were small. Implicit preferences for straight people were predicted to increase by just .02 points at the October 1 breakpoint in each model, which corresponds to a Cohen's d of .04 [.01, .07].

Test 4. Conducting parallel analyses for 2010–2013 (i.e., the control years) showed that with one exception (the 3-month model in 2012), discontinuities at October 1 did not significantly differ from zero (coefficients and 95% CIs for each year are shown in Table 1). The discontinuity for October 2014 was always directionally larger than that for previous Octobers, but these differences were generally not statistically significant (see Table 1 for details).

Alternative breakpoints. Our preregistered specification of the October 1 breakpoint for the regression discontinuity analyses was guided by events (i.e., the first Ebola case diagnosed within the United States), by media coverage, and by Google search volume. Nonetheless, alternative breakpoints are plausible; as Figure 1 shows, media coverage of Ebola increased throughout the summer of 2014 and reached an earlier plateau in August. We therefore fit regression discontinuity models specifying two alternative breakpoints: September 1 and August 1. Neither of these showed a significant discontinuity in the expected direction at the breakpoint. The September 1 model showed no discontinuity, $b = .007$, $t(18{,}880) = .521$, $p = .603$; the August 1 model showed a marginal discontinuity toward more *positive* attitudes toward gay men and lesbians, $b = -.029$, $t(18{,}880) = -1.91$, $p = .056$.

Confirmatory Analyses for Explicit Preferences

Test 1. A two-tailed t-test comparing mean explicit preferences in October 2014 ($M = .65$, $SD = 1.07$) to mean explicit preferences from January through September 2014 ($M = .66$, $SD = 1.07$) revealed no difference in explicit preferences, $t(42{,}566) = -.39$, $p = .69$, Cohen's $d = -.01$ [−.03, .02]. Recall that these values could range from −3 to +3 and are scaled such that higher values indicate a preference for straight people over gay people (with 0 indicating equal liking). Thus, participants in both time periods showed a small preference for straight over gay people on average.

Test 2. A two-tailed t-test comparing mean explicit preferences in October 2014 ($M =.65$, $SD = 1.07$) with mean explicit preferences from October 2010, 2011, 2012, and 2013 ($M = .78$, $SD = 1.14$) revealed that explicit preferences for straight people—like implicit preferences—were *weaker* in 2014 than in previous years, $t(26{,}898) = -7.73$, $p < .001$, Cohen's $d = -.11$, CI [−.08, −.014].

Test 3. A regression discontinuity analysis comparing explicit preferences before and after October 1, 2014, showed no significant discontinuity at October 1, $b = .032$ (95% CI: [−.01, .08]), $t(19{,}460) = 1.44$, $p = .149$, $d = .02$, CI [−.01, .05].

Test 4. Discontinuities at October 1 for 2010–2013 did not significantly differ from zero (coefficients and 95% CIs for each year are shown in Table 1 in the first column). The discontinuity for October 2014 was always directionally larger than that for previous Octobers, but these differences were only significant for 2011 (see Table 1 for details). When we computed a weighted combined coefficient ($b.1$) for 2010–2013 (Becker & Wu, 2007), this value fell inside the 95% CI of the 2014 coefficient ($b.1_{4\ month} = -.001$, 2014 CI [−.011, .075]). Thus, the estimate for 2014 did not differ from the 2010–2013 estimates.

Exploratory Analyses for Explicit Preferences

As we did for implicit preferences, we tested two additional exploratory models with different ranges of days. As before, in the 3-month model, the control days were July 1 to September 30; and in the 2-month model, the control days were August 1 to September 30. Neither of these models showed significant discontinuities at October 1, 3-month model $b = .031$ (95% CI [−.017, .080]), $t(16{,}961) = 1.27$, $p = .206$, $d = .02$, CI [−.01, .05]; 2-month model $b = .022$ (95% CI: −.038, .083), $t(14{,}974) = .73$, $p = .467$, $d = .01$, CI [−.02, .05].

Alternative breakpoints. Regression discontinuity analyses with the alternative August 1 and September 1 breakpoints did not show significant discontinuities in August 1, $b = .038$, $t(19{,}462) = 1.038$, $p = .299$; nor at September 1, $b = -.02$, $t(19{,}462) = -.659$, $p = .510$.

Discussion

We examined whether the Ebola outbreak of 2014, a naturally occurring pathogen threat, was associated with an increase in implicit preferences for straight people over gay people in the United States. We found mixed evidence for this hypothesis—t-tests comparing mean implicit attitudes in October 2014 to the previous months in 2014 found no shift in attitudes, but the more sensitive regression discontinuity analyses showed evidence of a very small shift in attitudes in October 2014, which was not evident in 2010–2013 combined. Even so, the shift in 2014 was only statistically significant in two of the three model specifications and was not consistently significantly different from the shift in previous years, examined individually. We found no shift in explicit attitudes in any analysis. These results should be interpreted in light of our sample sizes, which were large. In total, our sample comprises 248,922 participants. For 2014 only, analyses included between 42,566 and 14,535 participants, depending on the analysis.

Our preregistered analysis plan stated that all analyses of implicit attitudes needed to provide evidence consistent with the hypothesis to be considered confirmation. In those terms, it is clear that we did not confirm our hypothesis. However, the inconsistent results allow both optimistic and pessimistic interpretations. Two of us (Inbar and Pizarro) find the optimistic interpretation more compelling; the other two (Westgate and

Nosek) find the pessimistic interpretation more compelling. We therefore give both and let readers decide for themselves.

The Optimistic Interpretation

Results were clearly inconsistent across analyses, but it is possible that we detected only inconsistent evidence because the shift in attitudes was real but very small. If this were the case, society-wide pathogen threats could have real consequences for gay and lesbian individuals in aggregate, as even small differences in attitudes and behavior can have substantial effects when multiplied across millions of individuals (Greenwald, Banaji, & Nosek, 2015). We see three reasons to believe that there was in fact a shift in implicit attitudes in response to Ebola. First, the regression discontinuity analysis gave very similar estimates regardless of the exact model specification (i.e., they did not depend on one particular specification). Second, the estimated shift in attitudes for October 2014 was directionally larger than all previous Octobers and significantly larger than previous Octobers in aggregate. Third, our preregistered analysis plan prevented us from cherry-picking the specific analysis that supported one account over another, and thus the fact that the more sensitive of our two preplanned analysis showed evidence of an effect should be given more weight. Of the three, we believe the last reason is the most important, and it highlights the benefits of preregistered analyses, especially for complex data sets where many different kinds of analyses could be justified.

The Pessimistic Interpretation

Our prespecified plan required that four tests with extremely high power converge toward a single conclusion in order to conclude that naturally occurring pathogen threat altered preferences for gay compared to straight people. With implicit measures, we observed no effect on one, a reverse direction on a second, and weak but consistent evidence on the other two. With explicit measures, discussed a priori as of secondary interest, we observed no effect on any of the four tests. If we adopt our prespecified criteria, then this pattern fails to confirm our hypothesized outcome.

If we increase flexibility in our criteria, then we are still confronted with selective evidence for an effect—implicit not explicit, and two of the four implicit tests. Moreover, with such extremely high power, the two "successful" tests should have had p values nearing 0 but were both $p > .01$. Finally, our robustness tests for the successful tests were not independent, so the apparent consistency of p values is not indicative of independent confirmations. Altogether, the substantial variation in outcomes and weak effects could encourage selective reasoning and weighting of positive evidence over negative evidence for our hypothesized outcome. It is difficult to mentally simulate, for example, how we would have reasoned had the evidence been stronger for the first two implicit tests, or if the explicit tests had the hypothesis-consistent evidence instead of the implicit ones. As such, the most defensible conclusion is that these data did not support the hypothesis.

Limitations and Generalizability

Project Implicit volunteers are a more diverse group than typical undergraduate samples, but they are not a representative or randomly selected sample of Americans—they are volunteers who chose to visit a website. It is therefore possible that we sampled individuals who were particularly likely, or particularly unlikely, to respond to the threat of Ebola. We cannot rule this possibility out entirely, but it is not clear why it would obtain—and, moreover, it applies to any study not employing a randomly selected representative sample.

Additionally, these data were not originally collected with the aim of testing the effects of disease vulnerability, or of Ebola in particular, on attitudes. We therefore do not have measures of how much Ebola-related news participants were exposed to, how vulnerable they felt to Ebola personally, or how salient these concerns were to them as they were completing the study. Although Ebola was a major news item at the time (as shown by our count of news stories), and concerning to individuals (as shown by Google search trends), we have no way to assess how much it was on the minds of our participants in particular. Finally, our data are, of course, correlational—so any shifts in attitudes could be the result of third variables rather than increased pathogen threat.

We chose to examine attitudes toward gay men and lesbians because we expected, based on past research and theory, that these attitudes would be particularly responsive to pathogen threats—and thus these testing whether these attitudes shifted in response to Ebola seemed the clearest test of BIS theory. The BIS literature has typically not shown a link between pathogen threat and attitudes toward all lower status groups; rather, these effects seem to be specific to foreign out-groups (especially unfamiliar ones) and those groups seen as violating traditional moral norms and standards (especially in the sexual domain). For example, disgusting odors increased explicit negativity toward gay men but not African Americans (Inbar et al., 2012), and images priming pathogen threats increased implicit negativity toward gay people but not Arabs (Dasgupta et al., 2009). It is not clear, therefore, to what extent the current results should be expected to generalize to attitudes toward other groups. Perhaps because Ebola originated in Africa, the threat of Ebola would increase negativity toward immigrants generally, African immigrants, or even African Americans. It is not clear that BIS theory would straightforwardly predict such a link, but ultimately this question will need to be answered by future research.

Conclusion

Previous research taken to support behavioral immune system (BIS) theory has either primed pathogen threats in laboratory studies (e.g., Dasgupta et al., 2009; Faulkner et al., 2004; Inbar et al., 2012) or has examined whether geographic variation in pathogen threats is associated with differences in attitudes and values (e.g., Fincher & Thornhill, 2012; Schaller & Murray, 2008). We believe that the current study is an important complement to this previous research—and an important test of the theory it is taken to support. After all, BIS theory is ultimately meant to explain how individual attitudes and behaviors respond to variation in real, society-wide pathogen threats. The current results can be taken as good news or bad news for the proposed connection between pathogen threat and social attitudes derived from BIS theory. On the one hand, there is some evidence of a pathogen-related shift in attitudes toward gay men and lesbians. On the other, the shift, if it does exist, is very small. These results highlight both the predictive utility of BIS theory and the need to make a more serious effort to uncover its generality and boundary conditions.

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Notes

1. Factiva search (conducted on October 12, 2015) for articles containing "Ebola" in "major news and business sources" in region "United States" between January 1, 2014, and December 31, 2014.
2. Using the LexisNexis query "(Ebola) and Date(geq(*start date*) and leq(*end date*))" for each month. The search included transcripts from: ABC News, American Public Media, CBS News, CNBC News, CNN, Fox News Network, MSNBC, National Public Radio, NBC News, and Federal News Service.
3. Regression discontinuity tests whether scores on the dependent variable show a discontinuity, or "break," at a particular value of the independent variable. We fitted a regression discontinuity model that tested the linear trend in preferences for straight people over gay people as a function of day and specified October 1 as the breakpoint. To test for a discontinuity, the (dummy coded) "treatment" variable is entered as a covariate, producing the following regression equation (Lee & Munk, 2008; Trochim, 1984): $Y = b_0 + b_1 Z + b_2 X + e$.

. Where Y = outcome variable (implicit association test [IAT] D score or explicit preference), Z = treatment dummy variable (dummy coded; 1 = post-October 1, 0 = pre-October 1), X = identification variable (difference between observed date and cutoff date), b_0 = intercept, and e = random error term. Note that the regression coefficient for Z (b_1) is the estimate of the size of the discontinuity in units of Y.

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