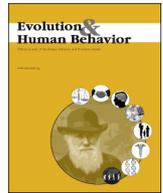




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Pathogen disgust requires no defense: a response to Shook, Terrizzi, Clay, & Oosterhoff (2015)

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We thank Shook, Terrizzi, Clay, and Oosterhoff (STCO) for their careful reading of our paper (Tybur, Inbar, Güler, & Molho, 2015). We will briefly address their statistical critiques, which are specific to our paper, before commenting on issues of measurement and theory, which are relevant to this broader literature.

1. Statistical analyses

STCO criticize our analytic strategy on multiple fronts. First, they object to our modeling of error covariances between endogenous ideology variables in path analyses. Failing to model error covariances assumes that conservatism measures are completely uncorrelated, except to the extent to which they are related to model predictors. As STCO demonstrate, models of this assumption fit the data poorly. The fit of such models is irrelevant to the theory being tested in our article or STCO's response, though—it merely demonstrates that, say, social conservatism correlates with agreement with the Republican Party. Second, after previously objecting to using measures that blend economic and social conservatism (Terrizzi, Shook, & McDaniel, 2013), STCO curiously criticize us for not blending our diverse conservatism measures into a single latent variable. STCO's proposal will be difficult to evaluate empirically if it can neither be tested by treating social and economic conservatism separately nor by averaging across social and economic conservatism. Finally, STCO object to our use of the routine practice of interpreting model fit statistics for theory testing; this criticism is especially peculiar given STCO later employ these same fit statistics in their analyses. On the whole, STCO's statistical critiques do not warrant change to our conclusions.

Nevertheless, to satisfy STCO's concerns regarding path models, we reanalyzed every relationship reported in our paper using the simplest mediation model possible. Using SPSS's PROCESS macro, we tested direct and indirect effects of pathogen avoidance on conservatism, mediated by sexual strategies. Across every measure in all three studies, we observe no direct relationship between pathogen avoidance and conservatism, though pathogen avoidance does consistently relate to conservatism indirectly via sexual strategies (see Table 1 for effects for "social" conservatism variables). Since publishing our paper, we have included the TDDS and the item "How would you describe your political orientation when it comes to social issues" in two studies (N 's = 347

and 490) using Mechanical Turk participants, the same group sampled in our manuscript and in STCO's commentary. In both data sets, we observe an indirect relationship of pathogen disgust on social conservatism via sexual disgust, but no direct relationship between pathogen disgust and social conservatism (see Table 1). In sum, across five large samples, we find that sexual disgust fully mediates any relationship between pathogen disgust and social conservatism. Even so, do these measures offer a fair test of the theories we and STCO describe?

2. Measurement

STCO's primary measurement critiques concern (1) our treatment of the TDDS sexual disgust subscale as a measure of sexual strategies and (2) our choice of conservatism measures. The first criticism exemplifies the so-called jangle fallacy (Uher, 2011)—assuming that two instruments measure different constructs based on surface level differences rather than empirical validation. Here's what we know about TDDS sexual and a widely used measure of sexual strategies, the SOI: The two instruments show similar relationships with Big Five and HEXACO personality instruments (Bourdage, Lee, Ashton, & Perry, 2007; Tybur, Bryan, Lieberman, Caldwell Hooper, & Merriman, 2011; Tybur & de Vries, 2013), respondent sex (compare Tybur & de Vries, 2013, and Tybur et al., 2011 with Schmitt, 2005), and attitudes toward recreational drug use, an issue strongly related to social conservatism (Kurzban, Dukes, & Weeden, 2010). In study 3 of our paper, the two variables were correlated $-.54$ ($-.63$ after disattenuating for unreliability), and they correlated almost identically with social conservatism (r 's = $.26$ and $-.23$, respectively). Of course, the SOI and TDDS sexual likely do not measure identical constructs, but protests against using the latter as a measure of sexual strategies based solely on a subjective reading of item content are not compelling.

STCO's criticisms of single-item measures of social and economic ideology are likewise unconvincing. Single-item measures of ideology, which are commonly employed in political psychology, predict attitudes and behavior well (Jost, 2006). Further, multiple-item measures of ideology (study 2) yielded conclusions identical to those based on single-item measures. We acknowledge both here and in our paper that results could vary across instruments, but we are left to wonder: if the theory predicts that pathogen avoidance relates to social conservatism, why not test the theory by asking participants how socially conservative they are? In contrast to STCO, we do not find it self-evident that a more valid assessment of social conservatism can be drawn

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Table 1
Direct and indirect effects of pathogen avoidance on social conservatism, with sexual strategy mediating the relationship between pathogen avoidance and social conservatism.

Study	Pathogen avoidance measure	Sexual strategies measure	Social conservatism measure	Bivariate correlation between pathogen avoidance and conservatism	Direct effect of pathogen avoidance	95% CI	Indirect effect of pathogen avoidance	95% CI
Study 1 (N = 819)	TDDS (pathogen)	TDDS (sexual)	Social conservatism	0.16	−0.01	−0.11 to 0.10	0.24	0.18 to 0.31
Study 2 (N = 238)	TDDS (pathogen)	TDDS (sexual)	Social conservatism	0.23	−0.10	−0.29 to 0.09	0.40	0.28 to 0.55
	TDDS (pathogen)	TDDS (sexual)	Traditionalism	0.25	−0.22	−0.38 to −0.07	0.52	0.39 to 0.65
	TDDS (pathogen)	TDDS (sexual)	Religiosity	0.26	−0.02	−0.06 to 0.03	0.10	0.07 to 0.13
	TDDS (pathogen)	TDDS (sexual)	Social dominance orientation	0.08	−0.02	−0.17 to 0.12	0.09	0.01 to 0.19
	DSR	TDDS (sexual)	Social conservatism	0.22	−0.08	−0.42 to 0.26	0.64	0.40 to 0.92
	DSR	TDDS (sexual)	Traditionalism	0.36	0.15	−0.14 to 0.43	0.69	0.46 to 0.97
	DSR	TDDS (sexual)	Religiosity	0.34	0.07	−0.01 to 0.16	0.14	0.09 to 0.21
Study 3 (N = 248)	DSR	TDDS (sexual)	Social dominance orientation	0.13	0.11	−0.16 to 0.38	0.11	−0.03–0.28
	TDDS (pathogen)	TDDS (sexual)	Social conservatism	0.10	−0.06	−0.27 to 0.15	0.20	0.10 to 0.33
	TDDS (pathogen)	SOI (Attitudes)	Social conservatism	0.10	0.09	−0.09 to 0.28	0.06	0.01 to 0.13
	PVD (Germ Aversion)	TDDS (sexual)	Social conservatism	0.10	0.04	−0.16 to 0.24	0.12	0.05 to 0.21
	PVD (Germ Aversion)	SOI (Attitudes)	Social conservatism	0.10	0.10	−0.10 to 0.29	0.06	0.01 to 0.15
Unpublished dataset 1 (N = 347)	TDDS (pathogen)	TDDS (sexual)	Social conservatism	0.08	−0.04	−0.21 to 0.13	0.16	0.08 to 0.25
Unpublished dataset 2 (N = 490)	TDDS (pathogen)	TDDS (sexual)	Social conservatism	0.18	0.04	−0.09 to 0.17	0.19	0.12 to 0.28

Note. All analyses were conducted using the PROCESS Macro for SPSS. Only one direct effect of pathogen avoidance on social conservatism was statistically significant (a negative direct relationship between TDDS pathogen and traditionalism). All but one indirect effect (that between the DSR and SDO via TDDS Sexual) were statistically significant. Further details on instruments can be found in Tybur et al. (2015).

from a latent variable estimated from Altemeyer's Right Wing Authoritarianism and Religious Fundamentalism scales and a Political Beliefs Scale of "25 belief statements involving clearly identifiable ideological stances" (Shook & Clay, 2011, p. 652), especially since neither STCO nor Shook & Clay (2011) describe item content or scale validation procedures for this instrument.

3. Theory

STCO misread our treatment of both the existing "outgroup avoidance" account of pathogen avoidance and conservatism and our alternative account, which considers sexual strategies (see Kurzban et al., 2010). STCO contend that we argue that "the adoption of socially conservative belief systems stems solely from sexual strategies." We did not (and do not) endorse this position, and we in fact explicitly pointed out that the majority of variance in social conservatism is unaccounted for by both sexual strategies and pathogen avoidance. STCO further suggest that a sexual strategies account is inconsistent with the fact that there are mean sex differences in pathogen avoidance, sexual strategies, and conservatism. Mean sex differences are in no way incompatible with our proposal that more pathogen-avoidant individuals might adopt more restricted sexual strategies, and more sexually restricted individuals might endorse rules favorable to their fitness interests. STCO also argue that we ignore findings suggesting that measures of pathogen avoidance relate to measures of prejudice. In fact, we cited and discussed multiple papers on pathogen avoidance and prejudice. In doing so, we stated that our results could not rule out the possibility that some ideological stances especially relevant to intergroup contact (e.g., anti-immigrant sentiments) relate to pathogen avoidance independently of sexual strategies.

That said, STCO's theoretical summary does raise important questions. First, are outgroup prejudice and social conservatism as interchangeable as STCO imply? To be sure, research conducted by social psychologists, who are almost universally liberal (Inbar & Lammers, 2012), has demonstrated that conservatives are more prejudiced

toward some groups (Brandt, Reyna, Chambers, Crawford, & Wetherell, 2014)—specifically toward the types of groups that liberals tend to like. However, recent findings suggest that liberals are intensely prejudiced toward their outgroups (e.g., anti-abortion advocates and Christian fundamentalists); this raises the possibility that liberals and conservatives are similarly prejudiced, just against different groups (Brandt et al., 2014). Similarly, like liberals, less pathogen-avoidant individuals are actually more prejudiced against some groups, such as Evangelical Christians (Crawford, Inbar, & Maloney, 2014).

Further, is group membership even a diagnostic cue of ecological background, and hence potential history of exposure to pathogens? Evidence suggests that human perceptions of groups (and resulting biases) are shaped by the nature of interdependent relationships between individuals (Yamagishi, Jin, & Kiyonari, 1999; Kurzban, Tooby, & Cosmides, 2001; Balliet, Wu, & De Dreu, 2014), and it is unclear how reliably interdependence correlates with ecological origin. Finally, in ancestral environments, did physical contact with individuals from foreign ecologies really pose a greater pathogen risk relative to physical contact with individuals from native ecologies? Some evidence suggests that this account is plausible (see Fincher & Thornhill, 2012, for an overview). However, other considerations urge caution in adopting this assumption (e.g., De Barra & Curtis, 2012).

Given these points, researchers might well consider alternatives to the outgroup avoidance account in interpreting results reported by STCO. For example, Murray et al. (2011) propose that departures from traditional rules and rituals—some of which evolve culturally to mitigate against pathogens endemic to the local ecology—increase infection risk. If Murray and colleagues are correct, then more pathogen-avoidant individuals might strategically adopt more conservative ideologies to avoid novel, pathogen-risky activities. Tybur, Lieberman, Kurzban, & DeScioli (2013) argue that contact avoidance varies as a function of both the pathogen costs of and benefits afforded by contact. More pathogen avoidant might be less willing to tolerate the pathogen risks of less beneficial contact with outgroups, even if intergroup contact poses no greater pathogen threat than intragroup contact. These perspectives,

as well as the sexual strategies account we presented in our paper, can be used to generate competing hypotheses, which can be tested in future work.

4. Summary

STCO suggest that findings from our manuscript be dismissed due to theoretical, methodological, and statistical inadequacies, and that our data and arguments do not warrant changes to the theoretical status quo. We disagree. At minimum, we believe that theory should be updated to account for the fact that (1) pathogen disgust does not relate to social conservatism independent of sexual disgust in five samples (three in our paper, and two others here), and that (2) sexual strategies fully mediate (in our five samples) or partially mediate (in STCO's one sample) the relationship between pathogen avoidance and social conservatism across a range of operationalizations of all three constructs. That said, our interpretation of the data might be wrong, and we enthusiastically welcome alternative hypotheses and new data to test those hypotheses. John Maynard Keynes is said to have quipped, "When the facts change, I change my mind. What do you do, sir?" We encourage researchers in this rapidly evolving area to adopt this sentiment, and to challenge, update, and refine theories in the light of new evidence.

References

- Balliet, D., Wu, J., & De Dreu, C. K. (2014). Ingroup favoritism in cooperation: A meta-analysis. *Psychological Bulletin*, *140*, 1556–1581.
- Bourdage, J. S., Lee, K., Ashton, M. C., & Perry, A. (2007). Big five and HEXACO model personality correlates of sexuality. *Personality and Individual Differences*, *43*, 1506–1516. <http://dx.doi.org/10.1016/j.paid.2007.04.008>.
- Brandt, M. J., Reyna, C., Chambers, J., Crawford, J., & Wetherell, G. (2014). The ideological-conflict hypothesis: Intolerance among both liberals and conservatives. *Current Directions in Psychological Science*, *23*, 27–34.
- Crawford, J. T., Inbar, Y., & Maloney, V. (2014). Disgust sensitivity selectively predicts attitudes toward groups that threaten (or uphold) traditional sexual morality. *Personality and Individual Differences*, *70*, 218–223.
- De Barra, M., & Curtis, V. (2012). Are the pathogens of out-groups really more dangerous? *Behavioral and Brain Sciences*, *35*, 85–86.
- Fincher, C. L., & Thornhill, R. (2012). Parasite-stress promotes in-group assortative sociality: The cases of strong family ties and heightened religiosity. *Behavioral and Brain Sciences*, *35*, 61–79. <http://dx.doi.org/10.1017/S0140525X11000021>.
- Inbar, Y., & Lammers, J. (2012). Political diversity in social and personality psychology. *Perspectives on Psychological Science*, *7*, 496–503.
- Jost, J. T. (2006). The end of the end of ideology. *American Psychologist*, *61*, 651–670.
- Kurzban, R., Dukes, A., & Weeden, J. (2010). Sex, drugs and moral goals: Reproductive strategies and views about recreational drugs. *Proceedings of the Royal Society B: Biological Sciences*, *277*, 3501–3508. <http://dx.doi.org/10.1098/rspb.2010.0608>.
- Kurzban, R., Tooby, J., & Cosmides, L. (2001). Can race be erased? Coalitional computation and social categorization. *Proceedings of the National Academy of Sciences*, *98*, 15387–15392.
- Murray, D. R., Trudeau, R., & Schaller, M. (2011). On the origins of cultural differences in conformity: Four tests of the pathogen prevalence hypothesis. *Personality and Social Psychology Bulletin*, *37*, 318–329. <http://dx.doi.org/10.1177/0146167210394451>.
- Schmitt, D. P. (2005). Sociosexuality from Argentina to Zimbabwe: A 48-nation study of sex, culture, and strategies of human mating. *Behavioral and Brain Sciences*, *28*, 247–275.
- Shook, N. J., & Clay, R. (2011). Valence asymmetry in attitude formation: A correlate of political ideology. *Social Psychological and Personality Science*, *2*, 650–655.
- Shook, N. J., Terrizzi, J., Clay, R., & Oosterhoff, B. (2015). In defense of pathogen disgust and disease avoidance: A response to Tybur et al. *Evolution and Human Behavior*. <http://dx.doi.org/10.1016/j.evolhumbehav.2015.06.003> [In this issue].
- Terrizzi, J. A., Shook, N. J., & McDaniel, M. A. (2013). The behavioral immune system and social conservatism: A meta-analysis. *Evolution and Human Behavior*, *34*, 99–108. <http://dx.doi.org/10.1016/j.evolhumbehav.2012.10.003>.
- Tybur, J. M., Bryan, A. D., Lieberman, D., Caldwell Hooper, A. E., & Merriman, L. A. (2011). Sex differences and sex similarities in disgust sensitivity. *Personality and Individual Differences*, *51*, 343–348. <http://dx.doi.org/10.1016/j.paid.2011.04.003>.
- Tybur, J. M., & de Vries, R. E. (2013). Disgust sensitivity and the HEXACO model of personality. *Personality and Individual Differences*, *55*, 660–665. <http://dx.doi.org/10.1016/j.paid.2013.05.008>.
- Tybur, J. M., Inbar, Y., Güler, E., & Molho, C. (2015). Is the relationship between pathogen avoidance and ideological conservatism explained by sexual strategies? *Evolution and Human Behavior*. <http://dx.doi.org/10.1016/j.evolhumbehav.2015.01.006>.
- Tybur, J. M., Lieberman, D., Kurzban, R., & DeScioli, P. (2013). Disgust: Evolved function and structure. *Psychological Review*, *120*, 65–84.
- Uher, J. (2011). Individual behavioral phenotypes: An integrative meta-theoretical framework. Why "behavioral syndromes" are not analogs of "personality". *Developmental Psychobiology*, *53*, 521–548.
- Yamagishi, T., Jin, N., & Kiyonari, T. (1999). Bounded generalized reciprocity: Ingroup boasting and ingroup favoritism. *Advances in Group Processes*, *16*, 161–197.