Taste Sensitivity Predicts Political Ideology

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Abstract:

Previous research has shown that political attitudes are highly heritable, but the proximal physiological mechanisms that shape ideology remain largely unknown. Based on work suggesting possible ideological differences in genes related to low-level sensory processing, we predicted that taste (i.e., gustatory) sensitivity would be associated with political ideology. In 4 studies (combined N = 1,610) we test this hypothesis and find robust support for this association. In Studies 1-3, we find that sensitivity to the chemicals PROP and PTC – two well established measures of taste sensitivity – are associated with greater political conservatism. In Study 4, we find that fungiform papilla density, a proxy for taste bud density, also predicts greater conservatism, and that this relationship is partially mediated by disgust sensitivity. This work suggests that low-level physiological differences in sensory processing may shape an individual's political attitudes.

Genetics play a significant role in determining a person's political orientation (1-2) – by some estimates explaining 30-60% of the variance in political liberalism/conservatism (2). However, the proximal mechanisms by which genetic differences are translated into political attitudes and behaviors remain largely unknown. One intriguing possibility is that some of the heritability of ideology may be due to genetic influences on low-level physiological mechanisms. Parts of the genome related to gustation (taste) and olfaction (smell) systematically differ between liberals and conservatives (3), suggesting that individual differences in sensory processing might play a role in shaping political ideology. Two additional lines of research converge to suggest possible associations between sensation – particularly taste – and political ideology. First, individual differences in taste sensitivity are related to sensitivity to disgust (4), an emotion focused in part on oral incorporation (5). Second, there is a robust association between disgust sensitivity and political ideology, such that people who are more disgust sensitive are more likely to hold conservative positions on certain political issues – particularly those related to traditional sexuality (e.g., gay marriage, abortion; 6, 7).

This research led us to hypothesize that physiological differences in taste sensitivity would be associated with differences in political ideology, and that this association would be mediated by sensitivity to disgust. We tested these hypotheses in four studies (total N = 1,610) that assessed taste sensitivity using commercially available chemical test strips (Studies 1-3) as well as tongue fungiform papilla density (Study 4). All materials, data, syntax, and preregistration documentation are available at https://osf.io/fv436/.

In Study 1, we provided an initial test of the association between taste sensitivity and political conservatism. To do so, we assessed participants' level of taste sensitivity using a widely used measure of taste sensitivity: taste strips containing the chemical compound 6-n-propyluracil (PROP, 8). PROP is a chemical that – depending on a person's genetically determined level of taste sensitivity – can be extremely bitter, completely tasteless, or anywhere in between (8, 9). Because sensitivity to PROP is associated with general taste sensitivity, it is an efficient method of assessing a person's overall level of taste sensitivity (8).

Participants (N = 320) from a large introductory psychology course at Cornell University were asked to place a PROP taste strip on their tongues for 30 seconds, and to rate the bitterness of the strip on two 100-point quasi-logarithmic scales (10), which asked participants to compare the taste sensation from the taste strips to other sensory experiences (the first scale asked about auditory sensations, and the second about sensation more generally; see SI). These scales have previously been shown to accurately identify between-subjects differences in taste sensitivity (10). Participants were also asked to indicate their general political orientation and their social and cultural liberalism/conservatism on 7-point Likert-type scales ranging from "extremely liberal" to "extremely conservative."

As predicted, participants reporting greater bitterness from the taste strip (i.e., those with higher taste sensitivity) self-identified as more politically conservative, both on the general political orientation measure (β = .14, $t(318)$ = 2.46, p = .01), as well as on the measure of social and cultural conservatism (β = .15, $t(318)$ = 2.73, p = .007). These results provided initial support for the hypothesized association between taste sensitivity and political ideology.

We next conducted a preregistered conceptual replication of this study, using a different measure of taste sensitivity and a more diverse sample of participants (N = 400) collected from a student and community center on Cornell University's campus. In this study, we asked participants to rate the bitterness of taste strips containing the chemical compound phenylthiocarbamide (PTC), another widely used index of general taste sensitivity (8). After

tasting the test strip, participants rated the intensity of the flavor that they experienced using the same general intensity scale from Study 1. Participants then reported their political orientation using the same scales from Study 1. Additionally, because both age and sex have previously been shown to relate to taste sensitivity (8, 11), we asked participants to provide this information in order to test whether these factors explained the observed association between taste sensitivity and political conservatism.

Replicating the results of Study 1, we found that greater taste sensitivity – this time as indicated by the intensity of bitterness experienced from the PTC strip – was associated with greater general political conservatism ($\beta = .19$, $t(396) = 3.80$, $p < .001$) and greater social and cultural conservatism ($\beta = .19$, $t(396) = 3.80$, $p < .001$). This association remained significant (and in fact became slightly stronger) when controlling for participants' age and sex (general conservatism: $\beta = .21$, $t(390) = 4.16$, $p < .001$; social/cultural conservatism: $\beta = .21$, $t(390) = 4.18$, $p < .001$), providing further evidence of an association between taste sensitivity and political conservatism.

In Study 3, we sought to extend these findings by moving to an issue-based measure of political conservatism, in which we asked participants to indicate their attitudes on 12 political issues, such as abortion, welfare, and restricting immigration (adapted from 12). We included this scale in order to determine whether taste sensitivity is associated with individuals' positions on specific political issues (and if so, which ones), or whether this association held only for overall ideological self-identification. Based on previous research on disgust sensitivity and political ideology (6, 7), we predicted that taste sensitivity would be most closely correlated with political issues related to traditional sexuality (e.g., LGBT rights, pornography, abortion). For this study, we also collected a more demographically and ideologically diverse sample ($N = 406$) recruited from two nearby shopping malls. Participants were given a PROP test strip and were asked to rate the intensity of the bitterness on the same general sensation scale used in Studies 1 and 2. They then answered questions about their political attitudes, age, and sex.

In this study, the association between taste sensitivity and self-reported political conservatism failed to reach statistical significance, although it was directionally consistent with our previous studies, with greater taste sensitivity being associated with greater political conservatism ($\beta = .07$, $t(399) = 1.45$, $p = .15$; social conservatism: $\beta = .06$, $t(395) = 1.19$, $p = .23$).[*] Additionally, we found that taste sensitivity significantly predicted greater conservatism on the issue-based ideology scale ($\beta = .11$, $t(390) = 2.27$, $p = .02$). Interestingly, contrary to our predictions, this relationship was weaker for issues related to traditional sexuality ($\beta = .04$, $t(390) = .70$, $p = .48$), and was stronger for other political issues (e.g., those related to immigration, gun ownership, and welfare benefits; $\beta = .15$, $t(390) = 3.05$, $p = .002$).

A meta-analysis of these studies (described below) revealed that although the association between taste sensitivity and self-reported ideology failed to reach statistical significance in this study, the size of this effect did not significantly differ from those obtained in our other studies (test of heterogeneity of effect sizes: $Q(7) = 8.0$, $p = 0.33$; test of moderation: $Q(1) = 3.31$, $p = 0.07$). This suggests that the somewhat smaller effect size observed in this study is likely due to random variation between samples (13), rather than to a meaningful difference between these studies. (Although it is common in the scientific literature to include only significant results (14),

[*] When controlling for age and gender, the association between taste sensitivity and issue-based conservatism remained statistically significant ($\beta = .16$, $t(379) = 3.15$, $p = .002$), the association with general political conservatism became significant ($\beta = .11$, $t(390) = 2.23$, $p = .03$), and the association with social/cultural conservatism became marginally significant ($\beta = .1$, $t(386) = 1.91$, $p = .057$).

we nonetheless report this study here in order to increase transparency in our research (13) and to provide a more accurate estimate of the true size of this effect (15)). Further, the significant association that we observed in this study between taste sensitivity and our issue-based measure of political ideology provides additional convergent evidence for our hypothesis that taste sensitivity is related to political conservatism.

Taken together, Studies 1-3 provided support for the hypothesized association between taste sensitivity and political orientation using the most established methods of measuring taste sensitivity, assessing participants' taste perceptions of the compounds PROP and PTC. Next, we sought to assess taste sensitivity with a more objective measure that did not rely on participants' self-reported taste experiences. To do so, in this study we used a direct physiological measure of taste sensitivity. Additionally, we included a measure of disgust sensitivity in order to assess whether disgust sensitivity mediated the relationship between taste sensitivity and political orientation. Finally, we included a wider range of demographic questions (e.g., race/ethnicity, income) to rule out the possibility that these factors might account for the observed association.

In this study, we measured taste sensitivity by assessing the density of fungiform papillae on participants' tongues. Fungiform papillae are small mushroom-shaped structures on the surface of the tongue that are the primary location of taste receptors (16). Greater fungiform papilla density indicates greater taste receptor density and higher taste sensitivity (16, 17). Importantly, because fungiform papillae can be directly observed, they provide a more objective means of assessing of taste sensitivity (16-18).

Participants (N = 484) were recruited from a student and community center on Cornell University's campus, and consisted of students, faculty, staff, and community members of diverse demographic backgrounds. In order to assess fungiform papilla density, we used a well-established staining procedure (18) in which participants' tongues are dyed with blue food coloring (which allows fungiform papilla density to be more easily observed) and photographed with a high-resolution camera. Participants then completed a set of demographic questions, a measure of disgust sensitivity (19, 20), and the two items assessing political orientation used in the previous studies. Trained research assistants provided three separate assessments of papilla density from the photographs. These assessments were highly reliable (ICC(2,3) = .87), and were therefore averaged into a single index of papilla density.

As predicted, we found that greater taste sensitivity – this time as measured by higher fungiform papilla density – predicted greater social/cultural conservatism ($\beta = .15$, $t(473) = 3.35$, $p < .001$), and marginally predicted greater general political conservatism ($\beta = .08$, $t(473) = 1.8$, $p = .07$). These patterns did not meaningfully change when controlling for demographic factors such as age, gender, and race/ethnicity (social/cultural conservatism: $\beta = .14$, $t(458) = 3.04$, $p = .003$; general conservatism: $\beta = .08$, $t(458) = 1.80$, $p = .07$). As predicted, we also found that disgust sensitivity significantly mediated the relationship between papilla density and social conservatism (10,000 bootstrapped samples, indirect effect 95% CI[.02,.07]), suggesting that this relationship is at least partially explained by the association between taste sensitivity and disgust sensitivity.

Following recent best-practices recommendations (13, 21), we conducted an internal, "within-paper" meta-analysis to determine the average effect size of the taste sensitivity-conservatism relationship. We used a random-effects model to better extrapolate these effects beyond the current studies and to the general population (22). Because we had a nested structure, with measures of both general and social conservatism collected from the same participants, we fit a multi-level meta-analysis model (see 23), specifying nested random effects for study and

measure type (general vs. social conservatism). The average effect size across these studies was β = .13 (se = .026, *z* = 4.87, *p* = .000001, Fig. 1), and the 95% confidence interval for the true effect size was β = .08-.18. We also computed separate average effect sizes for general conservatism and social conservatism. Both analyses yielded similar estimates (general conservatism: β = .12 (se = .029, *z* = 4.12, *p* < .0001, 95% CI[.06, .18]); social conservatism: β = .14 (se = .028, *z* = 5.01, *p* < .0001, 95% CI[.08, .19])). Cochran's Q-test was not significant (*p* = .33), suggesting that our effect sizes were relatively homogenous.

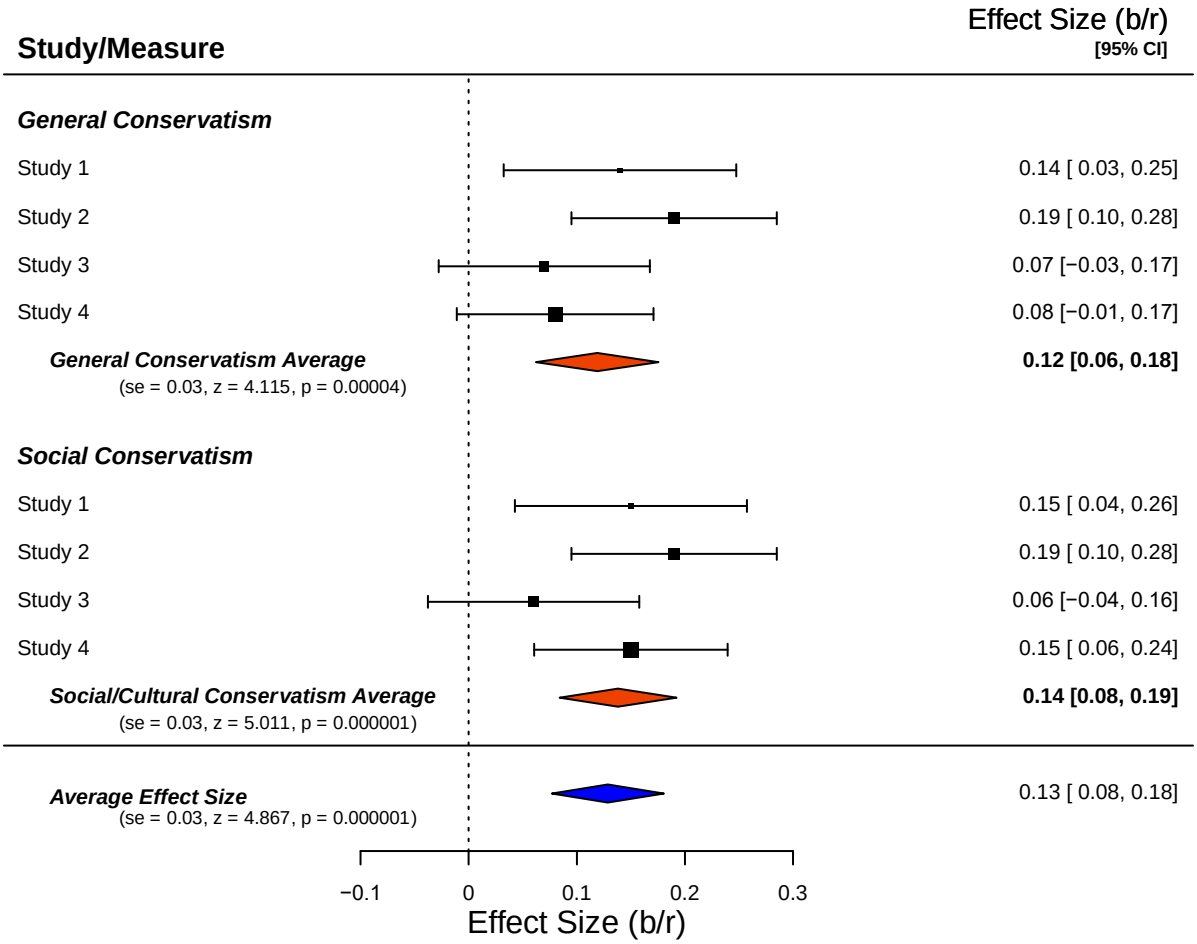

Fig. 1 | Forest plot illustrating the relationship between taste sensitivity and both general and social conservatism, Studies 1-4.

Across four studies using diverse methodologies, we found consistent evidence for an association between taste sensitivity and political orientation, such that individuals higher in taste sensitivity were more politically conservative than those lower in taste sensitivity (Figs. 1 & 2). We also found evidence (Study 4) that this association is at least partially explained by the link between heightened taste sensitivity and heightened sensitivity to disgust.

Although the participant samples in these studies were localized to a relatively small geographic area, they were nonetheless diverse in their relevant demographic characteristics

(e.g., spanning an age range of 73 years and with up to 49% of the sample identifying as non-White (Study 4)). The observed relationship between taste sensitivity and political conservatism was not reliably moderated by age, gender, or race/ethnicity, indicating that the taste-ideology link emerges to an equal degree across these major demographic subgroups. These findings, as well as the fact that both the taste-disgust and disgust-conservatism links have been observed by other research groups (e.g., 4, 24, 25), have strong theoretical support (5, 26, 27), and (in the case of the disgust-conservatism association) have been observed across different cultures (25, 28), lead us to conclude that the observed association between taste sensitivity and ideology is likely to generalize beyond the samples examined here. However, future research should seek to establish the breadth of this effect and to further examine the psychological mechanism(s) that underlie it.

Although the correlational nature of these data does not allow us to speak to the causal direction of this relationship, given that both PTC/PROP sensitivity and fungiform papilla density are largely genetically determined (9, 29), this research suggests that individual differences in taste sensitivity may serve as a biological predisposition that can lead an individual towards adopting one political ideology over another. More broadly, this work constitutes, to our knowledge, the first evidence of an association between low-level physiological differences in sensory sensitivity and complex attitudinal and belief systems, and suggests a possible biological mechanism that may underlie the high heritability of ideological beliefs documented in previous research.

Methods

A description of the procedure for each study is below. The online supplementary information contains a full list of all measures. All of our studies were approved by Cornell University's institutional review board, and all subjects provided informed consent. Data were analyzed with R 3.5.1 and SPSS 20.0.

Study 1: At the end of the class period, the instructor of the course briefly explained the content of the study to students ($N \sim 600$). They were asked to remain in their seats if they wished to participate, and were told that they were free to leave if they did not wish to take part. Research assistants distributed survey packets and taste strips to all students who remained in their seats. Students were told that if they did not wish to take part after receiving the survey packet, they could simply dispose of the materials. After completing the survey, students deposited the survey packets into designated containers on their way out of the class. The correlation between our two taste sensitivity scales was high ($r = .83$), so we averaged them into a single index of taste sensitivity.

Study 2: Research assistants set up a table in a student and community center on campus and invited passersby to participate in the study in exchange for a piece of chocolate. After tasting the test strip – but before rating its intensity – participants were first asked to rate the flavor of the strip, with the following response options: no flavor, bitter, salty, sour, or sweet (this question was not included in Study 1). Past research has shown that people typically experience the flavor of PTC to be bitter (8). However, because other work has shown that people often are unable to distinguish between bitter and sour flavors (30), we accepted responses of "sour" as well. All other responses (no flavor, sweet, and salty) were interpreted as indicating a lack of ability to taste PTC, and were coded as "0" for the intensity measure, as specified in our preregistered analysis plan.

After indicating the flavor that they experienced from the test strip, participants rated the intensity of that flavor. In addition to the questions about political orientation, age, and gender, participants also answered several questions regarding their food preferences. As specified in the preregistration documentation, however, the results of these questions were not analyzed in relation to the current research question.

Study 3: Research assistants set up a table at two shopping malls in the northeastern United States and invited passersby to participate in the study in exchange for a piece of chocolate. As in Study 2, participants rated the flavor of the strip before rating its intensity. As before, we coded responses of "no flavor," "salty," and "sweet" as "0" for the intensity measure. The content and format of the issue-based ideology scale was adapted from Everett, 2013 (12). However, we replaced some of the specific issues in order to include a wider range of issues relating to (non)traditional sexuality. For each of the 12 issues, participants rated the degree to which they felt positively or negatively towards the topic, on an 11-point Likert-type scale ranging from "-5 Extremely Negative" to "+5 Extremely Positive," with the midpoint rated "0 Neutral." The issues designated as relating to traditional sexuality were: the family unit, traditional marriage, LGBT rights (reverse-scored), abortion rights (reverse-scored), and pornography (reverse-scored). The issues designated as non-sexuality-relevant were: lowering corporate taxes,

reducing immigration, gun ownership, limited government, religion, traditional values, and welfare benefits (reverse-scored).

Study 4: Research assistants set up a table in a student and community center on campus and invited passersby to participate in the study in exchange for a piece of chocolate. Participants were first provided a vial of blue food coloring and a cotton swab with which they dyed the anterior (i.e., front) portion of their tongues. Participants were then given a round plastic hole reinforcement label (1/4" diameter) and were instructed to place the ring near the tip of their tongue, just to the left of center (see 18 for detail). A research assistant then photographed each participant's tongue using a high-resolution camera. Fungiform papilla density (defined as the number of papillae within the area demarcated by the white plastic ring; 31) was later assessed by trained research assistants.

After the papilla assessment procedure, participants tasted a Life Savers Pep-O-Mint® and rated the degree of sweetness and the "cooling rush" that they experienced from the mint (an exploratory taste sensitivity measure). Participants then completed the short-form, 5-item contamination subscale of the revised Disgust Scale (DS-R; 19, 20), which served as our measure of disgust sensitivity. Additionally, participants completed the 6-item Traditionalism subscale of the Authoritarianism-Conservatism-Traditionalism Scale (32) and answered questions assessing their political orientation, age, gender, ethnicity, economic political orientation, political party identification, political engagement, political news watching frequency, income, religion, religiosity, and place of birth.

Sample: In order to conduct a more conservative test of our hypotheses, we did not exclude any participants from our analyses. However, there were some participants who did not provide complete data for our independent and dependent variables, and who therefore could not be included in analyses.

Although we sought only to recruit participants aged 18 or older, a number of participants under 18 also participated in the study (3% of the total sample, $N = 53$). Because we had permission from the Cornell Institutional Review Board to recruit participants under 18, we include the data from these participants in our analyses. However, our results do not meaningfully change if these participants are excluded from analyses.

Statistical Analysis: We used linear regression to test our primary hypothesis that taste sensitivity would be associated with greater general and social political conservatism. For all analyses, we entered taste sensitivity as the independent variable and political conservatism as the dependent variable.[†] We considered our hypothesis to be supported if the relationship was positive (such that greater taste sensitivity was associated with greater political conservatism) and significant at $p < .05$. To test whether disgust sensitivity mediated the relationship between papilla density and social conservatism (Study 4), we used Andrew Hayes' PROCESS Macro for SPSS (33). The 95% confidence interval of the indirect effect did not include 0, indicating significant mediation.

[†] In a few instances, participants wrote in a value for their political orientation that was not explicitly listed on the scale (e.g., writing in "2.5" on the political orientation scale). We used the exact number provided by participants in our analyses. However, our results do not meaningfully change if these participants are excluded from analyses.

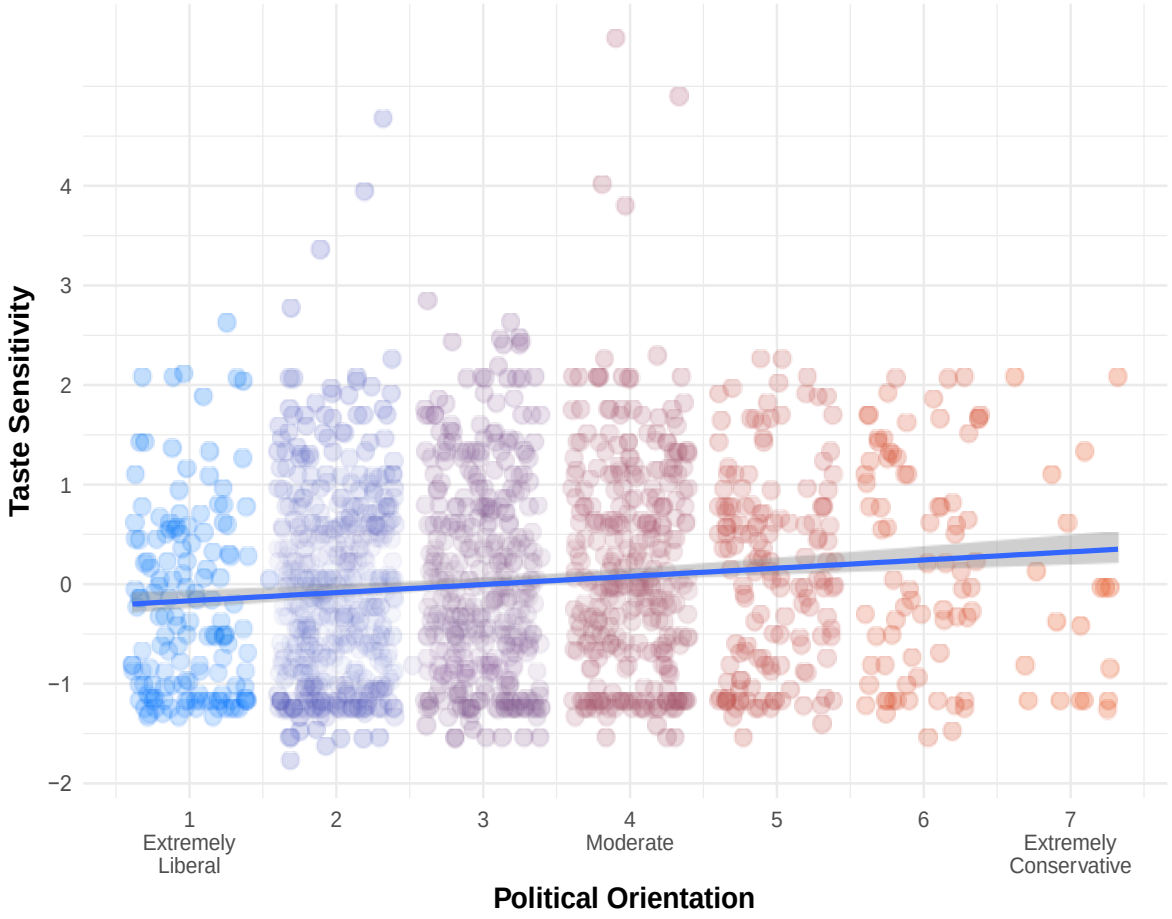

Fig. 2 | Scatterplot illustrating the relationship between taste sensitivity (standardized) and political orientation, Studies 1-4.

Data Availability

All materials, data, syntax, and preregistration documentation are available on the Open Science Framework at https://osf.io/fv436/.

References:

1. Funk, C. L., Smith, K. B., Alford, J. R., Hibbing, M. V., Eaton. N. R., et al. Genetic and environmental transmission of political orientations. *Polit. Psychol.* **34**, 805-819 (2013).

2. Hatemi, P. K., Medland, S. E., Klemmensen, R., Oskarsson, S., Littvay, L., et al. Genetic influences on political ideologies: Twin analyses of 19 measures of political ideologies from five democracies and genome-wide findings from three populations. *Behav. Genet.* **44**, 282-294 (2014).

3. Hatemi, P. K., Gillespie, N. A., Eaves, L. J., Maher, B. S., Webb, B. T., et al. A genome-wide analysis of liberal and conservative political attitudes. *J. Polit.* **73**, 271-285 (2011).

4. Herz, R. S. PROP taste sensitivity is related to visceral but not moral disgust. *Chemosens. Percept.* **4,** 72-79 (2011).

5. Rozin, P., Millman, L. & Nemeroff, C. Operation of the laws of sympathetic magic in disgust and other domains. *J. Pers. Soc. Psychol.* **50**, 703-712 (1986).

6. Inbar, Y., Pizarro, D.A. & Bloom, P. Conservatives are more easily disgusted than liberals. *Cognition Emotion* **23**, 714-725 (2009).

7. Smith, K. B., Oxley, D., Hibbing, M. V., Alford, J. R. & Hibbing, J. R. Disgust sensitivity and the neurophysiology of left-right political orientations. *PloS one* **6**, e25552 (2011).

8. Bartoshuk, L. M., Duffy, V. B. & Miller, I. J. PTC/PROP tasting: anatomy, psychophysics, and sex effects. *Physiol. Behav.* **56**, 1165-1171 (1994).

9. Barbarossa I. T., Melis, M., Mattes, M. Z., Calò, C., Muroni, P., et al. The gustin (CA6) gene polymorphism, rs2274333 (A/G), is associated with fungiform papilla density, whereas PROP bitterness is mostly due to TAS2R38 in an ethnically-mixed population. *Physiol. Behav.* **138**, 6-12 (2015).

10. Bartoshuk, L. M., Duffy, V. B., Fast, K., Green, B. G., Prutkin, J. & Snyder, D. J. Labeled scales (eg, category, Likert, VAS) and invalid across-group comparisons: what we have learned from genetic variation in taste. *Food Quality and Preference* **14**, 125-138 (2003).
11. Mojet, J., Christ-Hazelhof, E. & Heidema, J. Taste perception with age: generic or specific losses in threshold sensitivity to the five basic tastes?. *Chem. Senses* **26**, 845-860 (2001).
12. Everett, J. A. The 12 item social and economic conservatism scale (SECS). *PLoS One* **8**, e82131 (2013).
13. Lakens, D. & Etz, A. J. Too true to be bad: When sets of studies with significant and nonsignificant findings are probably true. *Soc. Psychol. Pers. Sci.*, **8**, 875-881 (2017).
14. Fanelli, D. "Positive" results increase down the hierarchy of the sciences. *PLoS One*, **5**, e10068 (2010).
15. Braver, S. L., Thoemmes, F. J. & Rosenthal, R. Continuously cumulating meta-analysis and replicability. *Perspectives Psychol. Sci.*, **9**, 333-342 (2014).
16. Miller Jr., I. J. Variation in human fungiform taste bud densities among regions and subjects. *Anat. Rec.* **216**, 474-482 (1986).
17. Zuniga, J. R., Davis, S. H., Englehardt, R. A., Miller Jr, I. J., Schiffrman, S. S., et al. Taste performance on the anterior human tongue varies with fungiform taste bud density. *Chem. Senses* **18**, 449-460 (1993).
18. Shahbake, M., Hutchinson, I., Laing, D. G. & Jinks, A. L. Rapid quantitative assessment of fungiform papillae density in the human tongue. *Brain Res.* **1052**, 196-201 (2005).
19. Haidt, J., McCauley, C. & Rozin, P. Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Pers. Indiv. Differ.* **16**, 701-713 (1994).

20. Olatunji, B. O., Williams, N. L., Tolin, D. F., Sawchuck, C. N., Abramowitz, J. S. & Lohr, J. M. The disgust scale: Item analysis, factor structure, and suggestions for refinement. *Psychol. Assessment* **19**, 281-297 (2007).

21. McShane, B. B. & Böckenholt ,U. Single-paper meta-analysis: Benefits for study summary, theory testing, and replicability. *J. Consum. Res.* **43**, 1048-1063 (2017).

22. Hedges, L. V. & Vevea, J. L. Fixed-and random-effects models in meta-analysis. *Psychol. Meth.* **3**, 486-504 (1998).

23. Konstantopoulos, S. Fixed effects and variance components estimation in three-level meta-analysis. *Res. Synth. Meth.* **2**, 61-76 (2011).

24. Herz, R. S. Verbal priming and taste sensitivity make moral transgressions gross. *Behav. Neuro.*, **128**, 20 (2014).

25. Terrizzi Jr, J. A., Shook, N. J. & McDaniel, M. A. The behavioral immune system and social conservatism: A meta-analysis. *Evol. Human Behav.*, **34**, 99-108 (2013).

26. Oaten, M., Stevenson, R. J. & Case, T. I. Disgust as a disease-avoidance mechanism. *Psychol. Bull.*, **135**, 303 (2009).

27. Tybur, J. M., Inbar, Y., Güler, E. & Molho, C. Is the relationship between pathogen avoidance and ideological conservatism explained by sexual strategies?. *Evol. Hum. Behav.*, **36**, 489-497 (2015).

28. Aarøe, L., Petersen, M. B. & Arceneaux, K. The behavioral immune system shapes political intuitions: Why and how individual differences in disgust sensitivity underlie opposition to immigration. *Amer. Pol. Sci. Rev.*, **111**, 277-294 (2017).

29. Melis, M., Atzori, E., Cabras, S., Zonza, A., Calò, C. et al. The gustin (CA6) gene polymorphism, rs2274333 (A/G), as a mechanistic link between PROP tasting and fungiform taste papilla density and maintenance. *PloS one* **8**, e74151 (2013).

30. Robinson J. O. The misuse of taste names by untrained observers. *Brit. J. Psychol.* **61,** 375-378 (1970).

31. Nuessle, T. M., Garneau, N. L., Sloan, M. M. & Santorico, S. A. Denver papillae protocol for objective analysis of fungiform papillae. *JOVE-J. Vis. Exp.* **100** (2015).

32. Duckitt, J., Bizumic, B., Krauss, S. W. & Heled, E. A tripartite approach to right-wing authoritarianism: The authoritarianism-conservatism-traditionalism model. *Polit. Psychol.* **31**, 685-715 (2010).

33. Hayes, H. A. PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling [white paper] (2012). Retrieved from http://www.afhayes.com/ public/process2012.pdf

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