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Political Attitudes Vary with Detection of Androstenone

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Abstract: Building on a growing body of research that suggests political attitudes are part of broader individual and biological orientations, we test whether the detection of the hormone androstenone is predictive of political attitudes. The particular social chemical analyzed in this study is androstenone, a non-androgenic steroid found in the sweat and saliva of many mammals, including humans. A primary reason for scholarly interest in odor detection is that it varies so dramatically from person to person. Using participants' self-reported perception of androstenone intensity, together with a battery of survey items testing social and political preferences and orientations, this research supports the idea that perceptions of androstenone intensity relate to political orientations, most notably preferences for social order, lending further support to theories positing the influence of underlying biological traits on sociopolitical attitudes and behaviors.

Key words: Androstenone; olfaction; political orientations; social order

Understanding the origins of public opinion has expanded from elite messaging, socialization, and group membership to include the possibility that attitudes toward group life may have some basis in our biology. That is, the social signals humans have generated and interpreted throughout the history of our species may continue to influence complex social behaviors like politics. Below we explore whether the detection of the hormone androstenone is predictive of political attitudes. We selected androstenone because of the variation in detection and preference for this odor in adult populations. If sensitivity to disgust^{1 2 3}, interpretation of facial expressions⁴, and responses to startling noises⁵ are associated with social protective policies, then it stands to reason that the ancient and powerful sensory detection system of olfaction also may continue to provide social cues today.

Olfaction is the most chemically-direct component of the sensory system, with its signals registering in the emotional centers of the brain without elaborate filters or mechanisms.⁶ Biologically, olfaction's origins are based on little more than a protein serving as a receptor -- a simple and direct sensory system that allowed primitive organisms to move toward or away from given chemicals detected in the environment. Neurophysiologist John Allman argues the evolutionary foundation of all behavior builds off this simple avoid-approach system, which in its most basic form can be thought of as a "lust-disgust" signal that attracts (or repels) organisms to particular environmental stimuli⁷. In more complex organisms, this primitive and powerful regulation mechanism evolved to allow olfaction to detect and transmit information about the social as well as the physical environment.

This is reflected in its unusually direct link to the CNS, as regions of the human brain tasked with olfaction and socioemotional processes overlap⁸. Odors register directly in the olfactory bulb, which is proximate to brain areas at the heart of emotion, memory, and sociality,

including the amygdala, hypothalamus, and orbitofrontal cortex⁹. As a result, odors exert a strong influence on behavior. For example, subjects presented with a strawberry while smelling the odor of an orange, for example, spread their grips as if they were reaching for the larger fruit. Conversely, participants spread their grip too narrowly in grasping an orange if the prevailing odor is of strawberries¹⁰. Retail outlets manipulate ambient smells because research suggests consumer behavior is situationally affected by odors^{11 12}, even when the scent is not strong enough to register in conscious thought¹³.

Individual-level variation in the physiological constitution of nervous systems is known to correlate with differences in behavior¹⁴, which has been suggested to be due at least in part to individual differences in the number of olfactory receptor genes¹⁵. Due in part to physiological variations in the way stimuli are sensed, some organisms experience the world differently than others and, as Vigil notes, how individuals process social stimuli differently may partly explain differences in political orientations¹⁶. For example, individuals who see emotionally neutral faces as threatening¹⁷ or who startle when they hear a loud and unexpected noise¹⁸ show an increased likelihood of harboring certain politically conservative orientations. Given that a large proportion of sensory input does not pass through consciousness¹⁹, it is important to note that the effects of sensory variations do not require the individual to be aware that something has been sensed for the sensory variations to manifest in behavior. We suggest that olfaction is a helpful next step in efforts to understand how and when political attitudes and orientations are biologically substantiated.

The Odor of Politics?

Given the central role olfaction plays in disgust detection and disgust's link to politics^{20 21}^{22 23}, we have borrowed its theoretical organizational scheme to think about how olfaction may

also connect to political opinions. Recent research identifies three primary functions of disgust: pathogen avoidance, mate choice, and social interaction -- sometimes labeled microbes, mating, and morality^{24 25 26}. As mentioned, the precursor to olfaction originated as a mechanism for identifying substances that single-celled organisms should approach or avoid. When more complex organisms began acquiring nutrients through ingestion rather than absorption, olfaction became a crucial indicator of what to ingest and, more importantly, what not to ingest. Thus, the first of three primary uses of the olfactory system is pathogen avoidance.

The second is mating. When certain animals began reproducing sexually rather than asexually, olfaction became an integral part of the process and continued to play that role even in humans^{27 28 29 30}, heightening the attractiveness of some prospective sexual partners while greatly reducing the attractiveness of others. Recent research in political science also supports the notion that olfaction may mediate the connection between political agreement and mate choice³¹.

The third fundamental role of olfaction pertains to morality or the following of social norms -- the focus of this research. From the beginning of social life, olfaction has been employed to identify offspring, close kin, and out-group members. Within a group, it is also valuable in identifying dominance hierarchies, conspecifics to avoid and befriend, and one's own place within the group^{32 33 34 35}. In short, the chemosignals crucial to olfaction serve as a means of social communication, especially as it relates to reproductive, territoriality, and both inter-group and intra-group behavior³⁶. When new challenges arise, existing systems typically modify so when social life began, the uses of olfaction broadened to include identifying offspring and to provide other socially valuable information. With the growing complexity of social life, individuals expanded the use of olfaction from its role in small scale dominance hierarchies and later, we test, to mass scale social life; that is, to politics.

Support for this conception is found in the physiology of olfaction. In mammals, olfaction depends on approximately 1,000 different receptors, each designed to detect the presence of a specific ambient, odor-causing chemical³⁷. Any given receptor is capable of identifying only a single chemical, though many odors contain more than one chemical and so activate a portfolio of olfactory receptors. The variety of receptor combinations allows organisms to identify a multitude of distinct odors, estimated to be 10,000 for *homo sapiens*³⁸. As might be expected, many olfactory receptors correspond to the chemicals emitted by foodstuffs; however, numerous other receptors are targeted toward odors associated with reproduction and sociality. For example, the peptides oxytocin and vasopressin, long known to have marked social implications^{39 40 41}, are detected by receptors in the olfactory system, and blocking these receptors in rats has been demonstrated to impair social recognition abilities and associated behaviors⁴². This fits with D'Amasio's⁴³ somatic marker hypothesis that emotion and its physiological correlates are key to decision making.

Even so, olfaction traditionally has not been taken seriously as a correlate of political orientations and behavior^{44 45}, perhaps because of the erroneous assumption that political judgments arise solely from conscious sensory input—a notion that recent research is beginning to correct^{46 47}. To date, the impetus for analyzing olfaction largely comes from the aforementioned broader interest in the connection of disgust to political views. Haidt and colleagues find judgments of political conservatives to be influenced more by “purity” concerns than those of liberals⁴⁸, and work by Inbar, Pizarro, and Bloom⁴⁹ shows a correlation between self-reported disgust sensitivity and political stances, particularly those pertaining to sexual attitudes such as gay marriage. The connection between political stances and disgust makes sense when one considers research demonstrating the impact of disgust on social interactions,

particularly with regard to violations of deep-seated norms such as marriages or emotional partnerships⁵⁰. Moreover, Smith et al.⁵¹ find that physiological responses to disgusting images, independently from self-reports, correlate with political attitudes toward gay marriage, though these effects seem to be moderated by gender⁵². As certain odors strongly evoke disgust, it is not surprising to find olfactory parallels to the correlation between disgust and certain social judgments.

Though previous research is suggestive that the primitive “pathogen avoidant” role of olfaction trickles over into moral and political judgments, our interest is in whether the aspect of olfaction that evolved specifically for social and political life is related to political orientations. In some respects, this is the more obvious approach, but it may be less obvious because socially-relevant odors tend to be much less likely than purity or disgust odors to enter conscious awareness. Many pathogen-relevant disgusting smells are immediately and unavoidably detectable, and responses to them visible (a contorted expression, gagging or vomiting), but at most realistic levels, the odors of socially relevant chemicals do not enter conscious awareness. This subtle nature of reactions to odors may have discouraged scholars from correlating political orientations and social odors. In any event, despite variations in how attitudes toward authority predict political differences^{53 54} and how olfaction relates to mate choice by political attitudes⁵⁵, we can locate no previous research that has tested for link between olfaction and attitudes toward authority and security.

Androstenone

The particular social chemical analyzed in this study is androstenone, a non-androgenic steroid found in the sweat and saliva of many mammals, including humans⁵⁶. Androstenone is a generic term typically applied to any of 16 chemical substances in the same family⁵⁷. Its

centrality to humans is indicated by ERP studies showing that androstenone elicits faster cortical responses than a broad range of “control” odorants⁵⁸. Androstenone, androstadienone, and androstanol are all part of this family of hormones, and which compound or substance researchers select for experiments seems more related to availability or popularity “than a logical and rational process of falsification.”⁵⁹

Scholarly interest in odor detection is due to its dramatic variation from person to person^{60 61}. Menashe et al. ⁶² call olfaction receptors “one of the most pronounced cases of functional population diversity in the human genome.” With regard to androstenone, though all humans produce it – with adult men producing higher levels than adult women -- numerous studies consistently report wide variation in both the intensity and valence with which androstenone is detected within the population. Even at concentrated dosages, some people do not smell androstenone at all. They are often referred to as androstenone anosmics and constitute somewhere between 10 and 40 percent of the population^{63 64}. Others report the odor of androstenone to be overwhelming while still others are somewhere in the middle, thereby making the distribution reasonably continuous. Among osmics, there are pronounced differences in whether androstenone is detected favorably or unfavorably. Some find the odor pleasing and compare it to sandalwood, incense, or vanilla; others dislike the odor and believe it to be similar to ammonia, sweat, or urine^{65 66 67}.

One reason for the marked variation in androstenone detection appears to be genetic differences. Heritability studies suggest a strong genetic role^{68 69}, and a gene labeled OR7D4 may be related to detection of androstenone (and the closely related androstadienone) but not to any other known odors⁷⁰ and has paved the way to examine the direct connections between specific genes and associated behaviors⁷¹. Though androstenone detection is undoubtedly

affected by environmental factors⁷², including the frequency of exposure to the substance – perhaps in the same way that taste sensitivity moderates visceral disgust sensitivity⁷³ – it is also partially based in genetics and “differences in the OR7D4 gene may have behavioral consequences beyond the psychophysical tests in a smell laboratory”⁷⁴.

Androstenone is also clearly important to human social life, and seems especially relevant to social perception and cognition⁷⁵. A number of studies confirm that the odor of androstenone alters social judgments, especially how females judge males. For example, after being exposed to androstenol (the alcohol version of androstenone), females usually evaluate males more favorably while males tend to be unaffected.⁷⁶ One study even finds that females are more likely to sit in a chair that has been treated with androstenone than one that has not^{77 78}.

Yet, few studies address androstenone’s potential relevance to the broader (non-mating) aspects of social life. Filsinger et al.⁷⁹ find that exposure to androstenone led men to rate other men as more passive. Kline, Schwartz, and Dikman⁸⁰ report that individuals more sensitive to the odor of androstenone tend to be less likely to give evidence of the personality trait known as defensiveness, in which negative traits (such as anger) are assigned to others but not assigned to oneself. Hummer and McClintock⁸¹ document that androstadienone (closely related to androstenone) heightens sensitivity and attention to emotions. For example, participants receiving androstadienone (instead of a control substance) on their lip exhibit reduced response times in a dot probe task if the dots appeared on the same side as an emotional (rather than a neutral) face. So, on one hand, androstenone detection is linked to a type of socio-pathology (defensiveness), but on the other, to the ability to use emotional cues to make decisions (akin to D’Masio’s somatic marker theory). As interesting as these studies may be, given the complete absence of any previous research on the effects of androstenone detection on politically rather

than sexually relevant variables⁸², at this stage, a priori theoretical expectations must be viewed as provisional. Despite androstenone's acknowledged "relevance to social life," we simply have little empirical or theoretical work on which to build.

Given androstenone's role in providing information about mating strategy and possibly social hierarchy related to mate selection, it might be possible that heightened olfactory sensitivity to androstenone could be positively related to authoritarianism or conservatism, or at least to that subset of conservative positions most pertinent to an established and secure social order. Vigil⁸³ finds that conservatives are more likely than liberals to attribute certain emotions (such as anger) to faces presented on a computer screen, and Oxley et al.⁸⁴ find that individuals who are conservative on selected "social order" issues are more likely than liberals to display an elevated startle reflex subsequent to an unexpected loud noise. Sensitivity to the emotional content of other people's odors, as well as to the emotional content of their faces, may be conducive to certain right-of-center political orientations.

A related line of reasoning is that, given its close relationship with testosterone⁸⁵, a substance often associated with aggression, competition, and risk-taking^{86 87}, those who readily detect androstenone in those around them may be more likely to seek comfort and protection in the arms of the secure, traditional social order that conservatives often hold out as the end goal of their policy preferences. Thus, heightened sensitivity to odors such as androstenone may be consistent with favorable attitudes toward decisive leaders, protection from both in-group rule-breakers and out-group invasions, and a desire to promote traditional rather than avant-garde lifestyles. This is not to say that conservatives possess higher levels of androstenone or testosterone than liberals but that they may be better able to detect hormones related to aggression. In sum, previous research provides a basis for exploring a positive relationship

between the intensity with which people report detecting a standardized concentration of androstenedione and political beliefs designed to promote a stable, secure social order with a clear authority structure^{88 89 90 91}.

Methods

The data used in this analysis were collected as part of a larger study conducted in the summer of 2010. A professional survey organization sent informational letters (to promote response rate) to a random sample of adults in the area surrounding a medium-sized Midwestern city, then followed up by phone, recruiting a sample of 340 individuals to come to a lab on a nearby college campus in exchange for \$50. Though the sample was drawn randomly, we make no claims that those eventually participating constitute a random sample. The restriction to a small part of the country and the requirement that participants travel to the lab undoubtedly introduce biases, but a national random sample is not necessary to explore the possible connection between political orientations and variations in androstenedione detection. Still, we are pleased to note that the group eventually participating is not a student sample and matches nicely with demographic figures on the overall adult population in the United States, though these individuals are more educated and predominantly white. The mean participant was 45 years old, had some college education and earned \$60,000 annually. The sample was 55% female and 95% white. Also reflecting the population from which it was drawn, marginally more participants self-identified as conservatives than as liberals, with many others identifying as moderates, but the important consideration is that substantial variation in political orientations was present.

Participants first completed a computer-based survey on their political beliefs, personal tastes and preferences, personality traits, and demographic characteristics. After completing a separate experimental task in an adjacent lab, they were escorted to a well-ventilated room where

they began a second computer-based survey protocol. Participants first answered the set of olfactory screening items used by Keller et al.⁹² that catalogue any characteristics or experiences that may interfere with the ability to detect odors overall (general osmia); for example, seasonal allergies, current respiratory infection, chronic alcoholism, endoscopic surgery, and current use of hormonal birth control. These questions were used as a strict filter. Any individual who indicated that one or more of these conditions applied to them was excluded from subsequent analyses, resulting in an eventual sample of 136. Thus, these filters for factors known to degrade the ability to measure general osmia at the time of the study substantially reduce the number of available cases, with seasonal allergies being the main culprit. Individuals removed from the analysis may be able to detect androstenone when their impediments to normal olfactory function (like seasonal allergies) are absent but need to be removed from the analysis because their current condition prevents accurate assessment of their detection abilities⁹³. The characteristics of the individuals in the reduced sample are quite similar to those for the complete sample: 51.4% male, some college, annual income of just under \$60,000, 91.2% white, and mostly conservative (39.4%) and moderate (34.3%). Similarly, differences between the full and reduced sample on our variables of interest (Table 1) were modest. For most of these variables, mean differences were not statistically significant and were substantively trivial.

After completing the screening questions, all participants – including those we later excluded due to possible osmic interference – engaged in an olfactory test. Amber-colored 40 ml bottles, labeled only with a number, were set up on the table next to the computer in the room. Directions on the computer screen instructed the participants to pick up each bottle, beginning with one labeled “#1”, unscrew the cap, place the bottle under their nose, and inhale gently. After recapping the bottle, they were asked to rate the strength or intensity of the odor (with 1 being

“smelled no odor” and 10 being “smelled a strong odor”) and then the favorability or valence of the odor (with 1 being “unpleasant odor” and 10 being “pleasant odor”). This same process was then repeated for the remaining bottles.

The bottles were presented in the same order for all participants. Bottle #1 contained 5 ml of a solution of androstenone (5α -androst-16-en-3-one) with solvent propylene glycol at a dilution of 1:1000. Though androstenone has 16 distinct derivatives, scholarly studies of androstenone typically employ one of two: Δ^4 , 16-androstadien-3-one (also known as androstadienone) or 5α -androst-16-en-3-one. They are closely related, and we employ the latter here in order to keep our work consistent with that of Keller et al.⁹⁴ and Knaapila et al.⁹⁵.

Bottle #2 contained only propylene glycol (5ml) as a check to ensure that the solvent itself did not have a detectable odor⁹⁶. Bottle #3 contained our control odor: 5 ml of a solution of citronella oil (Chinese 85/35%) diluted at 1:10,000 in paraffin oil. Citronella was used because it is an odor that is easy to detect and has no known specific anosmia⁹⁷. The central variable of interest in this analysis is the intensity with which each respondent reported detecting androstenone (Bottle #1).

In order to ensure that we are not merely uncovering *general* odor detection with sociopolitical attitudes, we correlated respondents’ self-reported perception of androstenone intensity with the control solvents. Detection of propylene glycol had a positive correlation with androstenone intensity ($r = .17, p < .05$), though not with self-reported pleasantness of the solvent ($r = .007, p = .96$). Likewise, citronella detection was positively correlated with androstenone intensity ($r = .39, p < .001$), though citronella’s perceived pleasantness was not ($r = .03, p = .74$). As a further check, we correlated detection and perceived pleasantness of propylene

glycol and citronella with the sociopolitical batteries in question and found no significant correlations between the control solvents and constructs of interest.

Variations in people's political orientations are measured in several different ways. One is an exclusively political version of the Wilson-Patterson Index⁹⁸, which asks participants how strongly they agree or disagree (on a five-point scale) with a set of 28 individual political items, including gay marriage, protecting gun rights, and increasing military spending (full listing in the Appendix). Responses to each item were coded such that higher scores correspond to a conservative position and then summed to obtain an overall measure of issue-based political conservatism. Using a schema developed by Smith et al.,⁹⁹ we measure broader social preferences using 15 items gauging the extent to which participants agreed or disagreed with statements like "government should not interfere with the fact that some people will be naturally more successful than others." Responses were coded such that higher scores for each of these items indicate more conservative preferences, with scores summed to obtain an additive "Society Works Best" (SWB) scale. For more information on Society Works Best, see Hibbing et al.,¹⁰⁰ as well as Friesen and Ksiazkiewicz.¹⁰¹

Finally, a distinct battery of five items asked respondents about their preferences for social order; for example, whether they prefer leaders to be firm and decisive, rule-breakers to be harshly punished, and public policies to stress protection. Responses were coded such that higher scores for each of these items indicate a stronger desire for clear social order and individual scores were summed to obtain an additive index.¹ These three batteries are highly correlated (r for SWB-WP = .75; r for SWB-Social Order = .65; r for WP-Social Order = .66) suggesting that, though they pick up unique features, they tap into a similar general construct. Age, gender,

¹ Items for preferences for social order and "Society Works Best" are listed in the appendix.

income and education were also recorded in the surveys taken by the participants and are included as control variables.

Results

We first investigate androstenone detection and political orientations using the aforementioned personality, psychological, and political batteries. In addition to the three measures of political ideological, the survey also tapped cognitive and personality patterns, including the Big 5 personality inventory (conscientiousness, emotional stability, openness, agreeableness, and extroversion), the BIS/BAS (behavioral inhibition and activation, respectively) scales, preference for literalism, and tendencies to be both disgust and threat sensitive. We have no strong expectations for the nature of the relationship between androstenone detection and these concepts but we do expect positive relationships for all three of our political batteries and particularly for the “preferences for social order” battery, a finding that would indicate that those with politically conservative and “authority attuned” positions tend to be more sensitive to androstenone.

The results for all of these batteries are presented in Table 1. The first column of numbers reports Pearson correlations between self-reported odor intensity and the corresponding variable. With regard to the Big-5 personality battery, we find no relationship between androstenone intensity and conscientiousness ($r = -.09, p > .10$), emotional stability ($r = .01, p > .10$), openness ($r = .02, p > .10$), agreeableness ($r = .11, p > .10$), or extroversion ($r = .07, p > .10$). Moreover, there was no significant bivariate correlation between behavioral inhibition ($r = -.06, p > .10$) or behavioral activation ($r = .02, p > .10$). Preferences for literalism were positively correlated with androstenone intensity, albeit at a relaxed level of significance ($r = .16, p < .10$), with higher preferences for literalism associated with higher self-reports of androstenone intensity. The same

trended for disgust sensitivity and androstenone intensity ($r = .16, p < .10$), with higher levels of disgust sensitivity being associated with more intense self-reports of androstenone detection.

Threat sensitivity was also positively correlated with androstenone intensity ($r = .17, p < .05$).

Table 1: Androstenone Detection Correlated with Personality, Psychological, and Political Batteries

Personality Batteries	<i>Corr.</i>	<i>Partial Corr.</i>
<i>Conscientiousness</i>	-.09	-.04
<i>Emotional Stability</i>	.01	.05
<i>Openness</i>	.02	.11
<i>Agreeableness</i>	.11	.13
<i>Extroversion</i>	.07	.12
Psychological Batteries		
<i>Behavioral Inhibition (BIS)</i>	-.06	-.11
<i>Behavioral Activation (BAS)</i>	.02	.02
<i>Literalism</i>	.16 [#]	.13
<i>Disgust</i>	.16 [#]	-.02
<i>Threat</i>	.17 [*]	.05
Political Batteries		
Society Works Best	.10	.13
Preferences for Social Order	.19 [*]	.21 [*]
Wilson-Patterson Full Battery	.10	.09
Sex/Reproduction Subset	.12	.12
Economic Issues Subset	.04	-.01

Two-tailed significance tests, # $p < .10$, * $p < .05$

Coefficients in the first column are simple correlations.

Coefficients in the second column are partial correlations controlling for age, gender, income, and education.

Turning to the political batteries, androstenone intensity was positively correlated with the Preferences for Social Order battery ($r = .19, p < .05$), with subjects reporting higher preferences for social order also typically reporting higher androstenone intensity. Intensity, however, was not associated with the Society Works Best scale ($r = .10, p > .10$) or full Wilson-

Patterson battery ($r = .10$, $p > .10$), nor was it associated with either the sex/reproduction ($r = .12$, $p > .10$) or economic issues ($r = .04$, $p > .10$) subsets of the Wilson-Patterson battery.

The second column reports partial correlations after accounting for the effects of age, gender, income, and education. The best indicator of the presence of an independent relationship is provided when standard control variables are partialled out (Column 2). We find no relationships between androstenone and either personality ($p > .10$ in all cases) or psychological ($p > .10$) batteries. There was no significant partial correlation between the Society Works Best scale and androstenone intensity ($r = .13$, $p > .10$), though we do find that androstenone intensity continues to exhibit a significant positive relationship with preferences for social order ($r = .21$, $p < .05$) even after accounting for the effect of our control variables. Neither the full Wilson-Patterson battery ($r = .09$, $p > .10$) nor the sex/reproduction subset ($r = .12$, $p > .10$) and economic issues subset ($r = -.01$, $p > .10$) were related to self-reported androstenone intensity.

With low effect sizes and non-significance, the strength of the connection between variations in androstenone detection and political views does not seem to be related specifically to economic or sexual morality items. The lack of relationship with sex attitudes is somewhat surprising, given androstenone's connection to gender signals in the extant literature, but this might indicate that androstenone affects inter-personal interactions, perceptions, and judgments but not necessarily preferences for sexual policies that would affect communities and society.

Though these results are somewhat promising, the simplicity of the models shown here – particularly those models showing systematic relationships between androstenone intensity and political batteries – demand more scrutiny. We are particularly interested in subjecting the relationship between respondents' preferences for social order and androstenone detection, given that it is both of central interest in this research and the only sociopolitical battery to show a

relationship with olfaction. Recall that in our correlational analyses, the scales were constructed through summation of their constituent parts, which, while parsimonious, risks confounding meaningful variance with error variance due to the fact that simple summation does not partition out the variability in individual items that are not related to the construct as a whole.

To further examine the relationship between preferences for social order in a more rigorous way, we constructed a structural equation model simultaneously specifying a factor model of the preferences for social order battery and then regressing the resulting latent factor for social order on androstenone intensity, sex, age, income, and education. The results of this analysis are shown in Table 2.

Table 2. Structural Equation Models Predicting Preferences for Social Order

Measurement	Coefficients
<i>LV: Preferences for Social Order</i>	
Traditional Values	1.000
Decisive Leaders	1.033** (0.198)
Protect Against External Threats	0.914** (0.163)
Strictly Punish Rulebreakers	0.923** (0.168)
Benefit the Rich	0.503** (0.122)
Maximum Govt. Involvement in Society	0.367* (0.157)
Regression	
<i>DV: Preferences for Social Order</i>	
Androstenone Intensity	0.121* (0.059)
Sex	0.146 (0.281)
Age	0.004 (0.011)
Income	0.234** (0.089)
Education	-0.134 (0.083)
χ^2	44.78
df	34
N	135
CFI	0.932
RMSEA	0.048

Two-tailed significance tests, * $p < .05$, ** $p < .01$

Standard errors in parentheses

The structural equation model was estimated using the *Lavaan* package in *R*.

The factor model for individuals' preferences for social order, when regressed on androstenone intensity and our control variables, continued to show a positive and significant relationship with androstenone intensity ($b = .121, p < .05$). As in the partial correlation for this survey battery, participants who reported higher intensities of androstenone detection were also typically more prone to having heightened preferences for social order. That this relationship persists when our data is subjected to increasingly rigorous methodological tests suggests that it is a connection between biology and preferences necessitating further investigation. Importantly, note that though there are known gender differences in androstenone detection and production,¹⁰² there is no relationship between sex and preferences for social order – so it might be possible that reported biological sex is not a moderator between androstenone intensity and preferences for social order.¹⁰³ These results, combined with the relationship between androstenone detection and our battery tapping preferences for organizing society, is consistent with our earlier theoretical speculation that androstenone detection would be most apparent on issues pertaining to securing the social order.

Discussion

In our sample, variations in androstenone detection appear to be relevant to variations in political – specifically preferences for order – but not psychological orientations. Economic and sexual morality issues appear to be unconnected to sensitivity to androstenone. As we noted earlier, the absence of a relationship with sex items is particularly interesting given that other research demonstrates sensitivity to pathogen-relevant disgust is indeed related to issue stances on sexual matters. Sensitivity to the human odorant androstenone appears to manifest itself

politically in quite a different fashion than sensitivity to pathogen-indicating odors (e.g., human excrement, vomit, spoiled food). Certain individuals are sensitive to the odor of androstenone, and they also tend to be the people who are attuned to and eager to squelch threats to the social order. We also recognize the limitations of our study. The sample is quite small, given the effect sizes of these relationships, and though we use an adult (rather than student) population, it is geographically constrained and racially homogenous. Because of these limitations, we have tried to be careful in drawing any broad conclusions or extending our findings to other populations other than the one from which we sampled. We hope that this effort at connecting these domains provides a foundation for future research, particularly for a priori power analysis, research design, and replication and extension.

Variation in androstenone detection has been related to small-scale social and emotional responses, such as reactions to facial images. In this study, we examined whether variation in androstenone detection is also related to mass-scale political orientations. Given the nature of androstenone as it relates to hormones like testosterone, we reasoned that, if there is a relationship with politics, it is likely to center on issues concerning dominance, authority, hierarchy, competition, leadership, and security; in short, social order. Preliminary tests support the connection of androstenone detection to general political orientations, with further indication that preferences for social order are more affected than preferences for policies related to the economy, sex, and reproduction. This relationship of androstenone to social order and hierarchy supports the hormone's connection to testosterone – that is, those sensitive to testosterone-related behaviors like aggression may desire strong leadership and tight ingroup coalitions to mitigate what they see as social disruption.

Setting aside the need to replicate this research at a larger scale, the evidence we present of a connection between olfactory sensitivity and political orientations is novel, intriguing and supports previous work on individual responses to various pheromones. The suggestive relationship between political orientations and olfactory sensitivity to the odor of androstenone should encourage additional work in olfaction and politics - not just that portion of olfaction related to disgusting odors. Though people are not consciously aware of their sensitivities to odors such as androstenone, it would appear that subthreshold detection is enough to exert a modest effect on some political orientations. Much like work conducted on non-conscious physiological responses to stimuli and associated political attitudes^{104 105 106}, subthreshold detection of environmental signals may help us bypass many of the problems with survey self-reporting and lead to a fuller understanding of individual variation in preferences for group life. It would be particularly useful to test larger samples that could be split or moderated by sex to detect differences in how male and female responses to the hormone may alter its relationship with social preferences. Measuring gender in addition to binary sex also might reveal nuance differences in gender orientation, gender identity strength, and attitudes toward strong leaders, social order and hierarchy.¹⁰⁷

Psychologists, biologists and geneticists have demonstrated human variation in every sensory system just as social scientists have been examining differences in social and political orientations and attitudes. Our work seeks to bridge these worlds in the hope of contributing to the understanding of the nature and origins of human political behavior and, broadly, public opinion. Few if any disciplines treat biological and behavioral variation as completely unrelated, yet much of the existing political science research does just that. This is a matter of empiricism. Just as parents, schools, peers, culture and time periods may influence socio-political attitudes

and behavior, we posit that the manner in which individuals process these environmental inputs may be just as important as the inputs themselves¹⁰⁸. Combined with the growing body of work connecting politics to behavioral genetics and physiology, we demonstrate olfaction should not be ignored in the examination of political attitudes and orientations.

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