8-2-2021

Political Taste: Exploring How Perception of Bitter Substances May Reveal Risk Tolerance and Political Preferences

Amanda Friesen
Western University, afries4@uwo.ca

Citation of this paper:
Friesen, Amanda, Aleksander Ksiazkiewicz, and Claire Gothreau. 2021. "Political Taste: Exploring How Perception of Bitter Substances May Reveal Risk Tolerance and Political Preferences." *Politics and the Life Sciences.* 40 (2): 152-171. Registered Report

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

Amanda Friesen, University of Western Ontario*
Aleksander Ksiazkiewicz, University of Illinois, Urbana-Champaign
Claire Gothreau, CAWP, Rutgers University

Political Taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences

* afries4@uwo.ca

Acknowledgements: Funding provided by the Association for Politics and the Life Sciences and IUPUI Office of the Vice Chancellor of Research Rapid Response Grants.

Abstract

Risk is endemic to the political arena and influences citizen engagement. We explore this connection by suggesting risk taking may be biologically instantiated in sensory systems. With specific attention to gender and gender identity, we investigate the connections between self-reported bitter taste reception, risk tolerance, and both of their associations with political participation. In three U.S. samples collected in 2019 and 2020, participants were asked to rate their preferences from lists of foods as well as N-Propylthiouracil (PROP) taster strips to rate whether they detect and rate the substance. In this preregistered report, we find that self-reported bitter taste preference, but not PROP detection, is positively associated with higher levels of risk tolerance as well as political participation. The pattern with gender and gender identity is mixed across our samples but interestingly, we find atypical for sex gender identity positively predicts political participation.

Keywords: Political participation, Bitter taste, Gender, Risk tolerance

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

Risk is endemic to the political arena. Issues are controversial, power is wielded and diminished, and emotions are high. Who decides to wade into this morass or avoid it altogether is the subject of much study. Beyond socialization, there is evidence that individual traits influence how and when people participate politically (Schreiber et al., 2013). We contribute to this growing body of evidence by exploring how risk tolerance and its relation to political engagement may be biologically instantiated in sensory systems. Specifically, we investigate the connections between genetic and self-reported bitter taste reception, its connection to risk tolerance, and both of their associations with political orientations We also consider the role of gender in the relationship between bitter taste reception, risk tolerance, and political orientations. Building these connections has the potential to help us better understand how individual dispositions and genetic variation could influence how people approach their social environments and how the social environment (e.g., contentious political arenas) may activate these dispositions to shape attitudes and behaviors.

Over the last decade, political scientists have increasingly been interested in the role of risk attitudes in a variety of different sociopolitical behaviors, such as political participation (Kam 2012), candidate choice (Kam & Simas, 2012), and participation in contentious politics (Tezcür, 2016). Politics inherently involves elements of risk. The benefits of participation in politics are not always clear, and almost all political acts "cost" something in terms of time, psychological investment, or money. Voting might seem like a low-risk way to participate in politics but even voting involves risk as voters can never be exactly sure what candidates will do once in office (Kam & Simas, 2012). Other work in the life sciences field has found that tolerance for risk has a genetic element, which is why humans vary in their tolerance for risk-taking (Karlsson Linnér et al., 2019). We focus on the gustatory system as taste serves as a way

for humans to gauge risk (Trivedi, 2012; Vi & Obrist, 2018), and previous research has found correlations between risk-taking personalities and spicy foods (Byrnes & Hayes 2016). Given that bitterness can be an indication of potentially toxic or poisonous foods (Bembich et al., 2010), yet many bitter tasting foods, such as leafy greens, are healthy and advantageous for us to consume, we suggest that bitter taste may be correlated with risk-taking behavior.

Bridging these literatures, we investigate the connection between genetic and self-reported bitter taste reception, its connection to risk tolerance, and both of their associations with political behavior. We consider the role of gender because although women tend to vote at higher rates than men, gender and politics scholars have consistently found gender gaps in political participation (Burns et al., 2001; Wolak, 2020). Furthermore, there are gender differences in risk tolerance with women being more risk-averse than men (Cross, Copping, & Campbell, 2011; Flynn & Mertz, 1994), as well as in bitter taste detection with women being more sensitive to bitter tasting substances (Bartoshuk et al., 1994; Duffy et al., 2004). We suggest that connections between bitter taste sensitivity and risk assessment strategies may shed light on biologically instantiated gender differences when it comes to risk tolerance in the political domain.

Although some of our findings were mixed across our three samples, we find strong evidence that self-reported preference for bitter tasting foods is associated with higher levels of risk tolerance. Bitter taste preferences are also associated with higher levels of political participation, particularly participatory activities that involve social risk. We found mixed evidence that the relationship between bitter taste and risk or bitter taste and political participation is conditional on sex or gender identity. Furthermore, we found no evidence that PROP detection is related to risk or political participation.

Taste Preferences and Social Behaviors

Though there is evidence of a connection between olfaction and political orientations (McDermott, Tingley, and Hatemi, 2014; Friesen et al., 2020,), very few political scientists have explored the sensory area of taste. Our sense of smell and taste chemically identify substances as either appetitive or dangerous, and taste distinguishes between sweet, salty, bitter, sour, and umami/savory (Higgs et al., 2015; Bachmanov & Beauchamp, 2007). Present day differences in bitter tasting manifest in variation in consumption of substances like coffee, beer, red wine, leafy greens, and dark chocolate, but the evolutionary development of these responses is related to the universality of bitterness indicating possible "toxic foods" or poison (Bembich et al., 2010; Higgs et al., 2015). Yet, some green, leafy vegetables that are obviously healthy are bitter tasting so "it would be most adaptive for us to be wary but not entirely repelled by bitter substances" (Herz, 2007, 187).

As individuals age and are exposed to bitter, non-toxic food and drink, they can "acquire taste," and often this occurs when we also use our olfactory sense (smell) in consuming these flavors or there are social influences on this consumption (Higgs et al., 2015, 211; Stein et al., 2003). It is important to note that many types of tastes may be acquired based on one's socio-economic status (e.g., wine, craft beers, leafy greens, non-local foods), but large genetic studies have revealed that coffee, tea, and alcohol consumption habits are related to the genetic variant associated with bitter taste (Ong et al., 2018). This helps demonstrate that even with this ability to adapt our bitter taste preferences, there continues to be individual variation (Sagioglou & Greitemeyer, 2016; Meier et al., 2012; Ong et al., 2018). Adjusting one's food preferences for nutritional or social reasons also could be adaptive and connected to other types of behaviors (Sagioglou & Greitemeyer, 2016).

Psychologists have looked at the association between bitter taste preferences and some social behaviors. Sagioglou and Greitemeyer (2014) conducted an experiment where participants either consumed a bitter or control beverage and were asked to provide behavioral responses to conflict situations that were provided in writing or asked to rate their interaction with another individual. Those who consumed the bitter beverages were more likely to provide hostile responses and ratings than the control group. Combining this finding with the extant research on the connection between pro-social behavior and enjoying sweet-tasting foods (Meier et al., 2012), Sagioglou and Greitemeyer (2016) posited that consistent exposure to bitter foods may create a "chronic" trait of personality hostility. Using two samples of American adults, they find that self-rated assessment of bitter foods corresponds with the anti-social indices of Machiavellianism, narcissism, and psychopathy, even when controlling for salty, sweet, and sour taste preferences.

There is evidence that differences in bitter taste responses are genetically based. Of particular interest is sensitivity to 6-n-propylthiouracil (PROP) and phenylthiocarbamide (PTC), related chemicals that taste bitter to tasters and are flavorless to non-tasters (Bartoshuk et al. 1994). Tasters and non-tasters display different patterns of brain activity when exposed to PROP, with heightened activity in prefrontal cortex among tasters and no change in activity among non-tasters (Bembich et al., 2010). Genetic variants in bitter taste sensitivity have several behavioral effects, especially regarding food preferences and dietary behaviors (Tepper, 2008). Among adults, greater perceptions of caffeine bitterness (from variants on chromosome 12) are associated with elevated coffee intake and lower tea intake, whereas greater perceptions of quinine bitterness (from variants on chromosome 12) and sensitivity to PROP (from variants in the TAS2R38 gene on chromosome 7) are associated with less coffee and alcohol consumption

(Ong et al., 2018). In an adolescent and young adult twin sample (mean age 16.2), Hwang and colleagues (2016) find a genetic association underlying the inverse relationship between bitter and sweet taste preferences that is in part dependent on variation in PROP sensitivity. Among children, variation in TAS2R38 is also associated with bitter taste sensitivity, lower thresholds for certain sweet tastes (e.g., sucrose), and more sugar consumption among 7- to 14-year-olds (Joseph et al., 2016; see also Mennella et al., 2005 for 5- to 10-year-olds), as well as lower consumption of bitter vegetables and American cheese among 4- to 5-year-olds (Keller et al., 2002).

Bitter Taste, Risk Assessment, and Gender

Importantly for the present research, several of the studies exploring bitter taste find that the results are moderated by gender, such that women and girls, on average compared to men and boys, are more sensitive to PROP and to bitter tastes and prefer sweeter tastes. However, this may be in part because a higher proportion of women are super-tasters who have a greater density of fungiform papilla (Bartoshuk et al., 1994; Duffy et al., 2004), rather than solely because of PROP sensitivity per se (see also Hayes et al., 2008). Cultural factors likely play an important role in how the relationship between gender, genetic predispositions, and food behaviors develop. For example, Keller and colleagues (2002) suggest that restrictive food strategies, which have gendered effects, may affect how PROP sensitivity translates into eating habits. Based on this literature, we expect PROP sensitivity to be associated lower bitter taste preferences and greater sweet taste preferences, and that this relationship may be stronger among women than men.

Individual differences in bitter taste preferences also have been linked to emotions (Macht and Mueller, 2007), but most links to personality have involved tasting sweet substances

and pro-social behaviors (Meier et al., 2012). Bitter taste exposure is associated with detecting emotions in faces (Schienle et al., 2017) and influencing one's personal mood (Dubovski, Ert & Niv, 2017), suggesting that these taste preferences continue to moderate social behaviors and perceptions of others. Although research into the properties of bitter taste perception itself goes back decades, links to the psychological and behavioral correlates of bitter taste sensitivity outside the domain of eating is very recent, across disciplines (though see Schreiber et al., 2013 for a discussion of neural correlates of these factors separately - sensory detection, risk-taking, and political orientations). Thus, it is quite timely to launch a political behavior study to contribute to the conversation of psychologists, geneticists, and other scholars seeking to understand the relationships between sensory experience and social behaviors. Given that interest and participation in politics are also linked to personality traits (Gerber et al., 2011; Mondak et al., 2010) and heritable factors (Dawes et al., 2014; Fowler et al., 2008; Klemmensen et al., 2012), it is worth exploring whether there are interconnections between interest and participation in politics with gustatory systems.

Though we are testing political participation, there is some evidence of a relationship between bitter taste sensitivity and political ideology. Ruisch, Anderson, Inbar, and Pizarro (in press) find that sensitivity to PROP and PTC, both measures of bitter taste sensitivity, are correlated with ideology, and in particular, social conservatism. This relationship was mediated by sensitivity to disgust. Furthermore, the authors use a more direct physiological measure of taste sensitivity -- the density of fungiform papillae on participants' tongues -- to test the same hypothesis. Greater density of fungiform papillae is an indicator of higher taste sensitivity and was also associated with more conservative ideology. Hibbing, Smith, and Alford (2013) also report unpublished findings from their lab connecting PTC detection and conservative ideology.

We are interested in understanding how bitter taste preferences might relate to political behavior, apart from ideology or the suggested pathway through disgust. Instead, we suggest that interests in bitter tasting substances might be related to risk-taking behavior. If bitter taste once signified poison but also could involve consumption of leafy greens, those who are able to tolerate or enjoy a bitter taste could be rewarded by healthy nutrients – or punished with sickness and possible death (in the case of actual poisonous substances). Gender differences in both risk tolerance and taste detections and preferences lead us to consider a possible connection between these three domains – bitter taste, risk-taking, and gender.

For example, extant research shows that women are more likely to be super-tasters, thus more sensitive to bitter substances, and are more likely to prefer sweeter tastes (Herz, 2007). Psychology research demonstrates that there are significant gender differences in risk assessment, with women being more risk-averse than men across various types of domains (Cross, Copping & Campbell, 2011; Nelson, 2015; Flynn & Mertz, 1994; Finucane et al., 2000; Bord & O'Connor, 1997; Garbarino & Strahilevitz, 2004; Waldron, McCloskey & Earle, 2005). Though our study is correlational and cannot determine causal order, we base our hypotheses on the extant literature and evolutionary theory to suggest that perhaps bitter taste tolerance co-develops with risk preferences, and this concurrence might explain some of the biological pathways of gender differences in risk behaviors.

Politics is inherently risky – from running for office to participation beyond simply voting -- individuals who demonstrate a low tolerance for general risk-taking are less likely to engage politically (Kam, 2012). Whether the result of socialized norms or evolved sex roles, women, on average, tend to be more conflict and risk avoidant than men so they eschew politics when it is competitive but may engage when the political sphere is perceived as consensual

(Mutz, 2006; Kam, 2012; Schneider et al., 2016; Wolak & McDevitt, 2011). In looking at the combination of personality traits, risk tolerance, and conflict avoidance, recent scholarship has found that what engages men in politics disengages women (Djupe, Friesen & Sokhey, n.d.). Women may be more interested in channeling their time and talents into spaces of group belonging and agreement (e.g., religious institutions) than areas of competition and conflict like politics (Friesen & Djupe, 2016).

The gendered nature of risk aversion and political engagement may be rooted in evolved responses toward sexual selection and social roles (Sweet-Cushman, 2016). From this perspective, competition among males for mates can partially explain why individuals choose to engage in risky behavior. Men tended to benefit more from engaging in risk-seeking behavior than women in terms of reproductive strategies. Using this logic, Sweet-Cushman (2016) proposes an evolutionary origin for candidate emergence. She posits that because women and men have faced different evolutionary pressures, they have developed different cognitive mechanisms for risk assessment. These differing cognitive strategies can impact the way that men and women evaluate risk in the political domain, and more specifically, in determining whether or not to run for office. Again, we suggest that perhaps bitter taste sensitivity and risk assessment strategies co-developed and may shed light on how biologically instantiated gender differences in risk-seeking in the political domain are. Due to the socially constructed nature of gender, we extend our analyses beyond sex assigned at birth to see how continuous measures of masculine and feminine gender identity relate to risk aversion and political engagement.

Hypotheses

Given that it is biologically most beneficial for humans to be wary of bitter tasting substances, but not entirely avoidant of them, we would expect the following:

$\boldsymbol{H_1}$**:** Tasters (those who can detect the PROP strip) are expected to be more *risk avoidant* than non-tasters in everyday life. Among tasters, high tasters (those who experience the bitter flavor of PROP more intensely) are expected to be more *risk avoidant* than low or medium tasters. Similarly, we predict the more an individual likes bitter tastes, as measured by their affinity for bitter foods, the higher they will score or risk-seeking/taking measures. These hypotheses are not specific to politics, but capture a broader behavioral expectation, and we assume both sensitivity and preference for bitter tastes will be predictive of risk tolerance, even when included in the same model.

We also expect that bitter taste, given its association with risk tolerance, would be associated with risk in the political domain:

$\boldsymbol{H_2}$**:** Taster status, bitter taste sensitivity, and bitter taste preference are expected to be associated with political behaviors such that tasters, those with greater bitter taste sensitivity, and those with lower bitter taste preferences will be less likely to participate in political activities that may involve social risk, including political discussions, attending a rally, and posting political content online.

Furthermore, we know from the taste literature that women have higher levels of bitter taste sensitivity, and scholars have demonstrated that there are significant gender differences in risk assessment, with women having less tolerance for risk than men. Therefore, we want to explore the interaction of gender and bitter taste preference on political participation.

$\boldsymbol{H_3}$**:** Women are not expected to be more likely to be tasters than men. However, women are expected to have greater bitter taste sensitivity among tasters and to express a lower preference for bitter flavors. We expect that this influences the willingness to participate in political activities that involve social risk.

Finally, in addition to testing the interaction of gender and bitter taste preferences on political participation, we also include a continuous measure of gender identity (Bittner & Goodyear-Grant, 2017; Gidengil & Stolle, 2020; Gidengil & Stolle, 2021) to explore how masculine and feminine gender identity relate to bitter taste sensitivity and political participation. These continuous measures of masculinity and femininity capture variation beyond conventional gender identity measures and allow for potential orthogonality between these identities.

$\boldsymbol{H_4}$**:** Those who identify as more feminine are expected to have greater bitter taste sensitivity among tasters and to express a lower preference for bitter flavors than those who identify as

more masculine. We expect that this influences the willingness to participate in political activities that involve social risk.

Methods

Samples

For our online sample using Qualtrics, we contracted with Bovitz Inc., Encino, CA, to use their proprietary survey panel Forthright to recruit a sample of adults living in the United States. Forthright recruits participants in their panel through both internet- and address-based sampling methods. Participants for this study were randomly selected within the Forthright panel and invited through email invitations or SMS text messages for those who opted in with their mobile phone numbers. Forthright accounts for variance in response rates by over-sampling certain demographic groups to ensure a nationally representative sample.

Our second and third samples were recruited from the student population at the University of Illinois in 2019 and 2020. This sample is younger than the general population, which can be preferable as the ability to detect bitter taste does decline with age (Cowart, Yokomukai, & Beauchamp, 1994).

Pilot Data and Power Analysis

A pilot study provided us with a preliminary estimate of effect sizes for our hypothesized relationships to assist with power analysis alongside the broader literature (for limitations of relying on pilot studies alone, see Kraemer et al., 2006; Albers & Läkens, 2018) and an opportunity to test our analytical strategy in order to uncover any unforeseen challenges. The data was collected from a sample of undergraduates registered in political science courses at the University of Illinois in 2019. In the first wave of data collection, students completed the taste inventory and risk-taking battery. We found that bitter taste preferences predict general risk

seeking with and without controls for gender identity and other taste preferences (standardized betas between 0.17 and 0.19).

We conducted several a priori power analyses using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007) to examine the statistical tests proposed in the analysis section. All power analyses assume .80 power with an alpha of 0.05. Previous explorations between bitter taste preferences and social traits and behaviors have resulted in small effect sizes – typically around .10 or .15 for the taste list preference (Sagioglou & Greitemeyer, 2016). Therefore, we proposed the nationally representative online survey sample of 1,000 to achieve 90% power.

Materials, Measures, and Procedures

In both samples, participants were asked to rate their food preferences from lists of foods developed by other scholars (Sagioglou & Greitemeyer, 2016; Meier et al., 2012), including sweet (candy, honey, ice cream, maple syrup, pears); sour (cranberries, lemons, limes, sour cream, and vinegar); bitter (cabbage, coffee, grapefruit, radishes, rye bread, tea, and tonic water); salty (bacon, beef jerky, green olives, pretzels, salty peanuts, and soy sauce); and spicy (cayenne pepper, chilies, curry, hot salsa, jalapeno peppers, and Tabasco sauce). Because of possible socialization and socio-economic differences in food preference development, we also used a non-food-related tasting behavior component common in bitter taste studies. To accomplish this, we relied on N-Propylthiouracil (PROP) taster strips (manufactured by Bartovation). Participants were asked to rate whether they detect the substance and how strongly and negatively they rate the taste (Hwang et al., 2016). The taster strip method is strongly correlated with other methods for measuring PROP sensitivity (Bartoshuk et al., 1994), like PROP ratio tests that rely on drinking solutions with progressively higher concentrations of PROP. In Studies 2 and 3, participants each rated one control paper strip (without PROP) and one treatment strip (with

PROP). PROP strips were administered in a lab environment in Study 2 in the Spring of 2019. Participants were asked not to eat or drink before coming to the lab and were given a bottle of water with which to rinse their mouth before self-administering each strip and rating it on flavor intensity, flavor profile, and pleasantness. Participants all completed the control strip before the PROP strip. Study 3 was administered in the Fall of 2020 during the COVID-19 pandemic. As a result, in-person administration was not possible. Participants were asked to provide a mailing address to which the taster strips could be sent. Participants who provided a mailing address were mailed the strips in separately sealed plastic bags and an instruction sheet asking them not to eat or drink before going to an Internet URL for the survey to complete alongside the strips. The survey followed procedures similar to those used in the lab in 2019 for self-administration of the control and PROP strips (with the control strip administered first).

All participants completed survey items that included a 7-item risk-taking battery (e.g., "In general, how easy or difficult is it for you to accept taking risks?" see Kam, 2012, a 40-item multiple domains of risk measure (Weber et al. 2002), attitudes about and experiences with COVID-19, and several demographic variables (age, gender, education). Our main outcome of interest is political participation, which will be measured using eight items adapted from Kam (2012). These items ask respondents to look to the future and assess their likelihood of participating in a series of acts that include rallies, marches, demonstrations, attending a local government or school board meeting, signing an e-petition, signing a paper petition, donating money to a political/social organization, attending a meeting on political/social issues, inviting someone else to attend such a meeting, and distributing flyers to support a political/social organization. We also asked about propensity to post about politics on social media. Response

categories to all items other than voting will be measured on a five-point scale from "extremely likely" to "not at all likely."

Age will be measured with an open-ended question. Income will be asked across a range of seven different categories of income brackets. We also wish to extend sex/gender measures beyond the binary male/female to include a self-placement on two dimensions - continuums from 1 to 7 on masculinity and 1 to 7 femininity. Following both past and recent research on the problems with standard conceptualizations and operationalizations of gender, we use these scales as to not treat gender as a dichotomy and to allow for distinctions in identity strength (Bem, 1976; Bittner & Goodyear-Grant, 2017; Gidengil & Stolle, 2020; Hatemi et al., 2012; McDermott, 2016; Wangerud, Solevid & Djerf-Pierre, 2018). Following Wangerud et al. (2018), we also include a categorical measure of gender identity as well as sex assigned at birth. This will help us to explore interactions between the categorical measures and the masculinity/femininity scales.

In our registered report, we suggested doing a series of exploratory analyses between bitter taste, Big 5 personality, Wilson-Patterson issue attitudes, and other measures. Due to space constraints and in the interest of focusing on our already complex set of results across multiple samples, we have elected to save those exploratory efforts for a future pilot project.

Results

Study 1 (Adult Sample)

We first discuss descriptive statistics of the sample and scale reliabilities, followed by the models described in the pre-registered analysis strategy. All significance tests are two-tailed. The central variables of interest in this study are bitter taste preferences, risk tolerance, sex, gender identity, and political participation. Our sample is 49.8% male and 50.2% female according to

the sex assigned at birth measure. Among male respondents, 39.2% rate themselves at the highest end of the masculinity scale and among female respondents, 37.9% rate themselves on the highest end of the femininity scale. All variables were recoded to range from 0 to 1 for ease of interpretation of the unstandardized coefficients. To create a bitter taste preference scale, we took the mean of all the bitter taste items we asked participants to rate ($\bar{x}$ = 0.55, Cronbach's alpha = .72).[1] The bitter taste subscale had the lowest average score in terms of taste preference compared to the sweet ($\bar{x}$ = 0.77), salty ($\bar{x}$ = 0.69), and sour ($\bar{x}$ = 0.62) taste subscales. We conducted the same procedure to create risk tolerance scales (Kam 2012 Scale: $\bar{x}$ = 0.49, Cronbach's alpha = .72; Weber et al. 2002 Scale: $\bar{x}$ = 0.31, Cronbach's alpha = .92) and a political participation index ($\bar{x}$ = 0.35, Cronbach's alpha = .91).[2] In terms of other demographic variables, our sample is 72.9% white, 27.1% non-white, has a mean age of 45.4, and 16.3% of respondents identify as Latinx. The median level of education is an associate's degree. Full demographic information can be found in the Appendix.

Based on a two-sample t-test, we found no significant sex differences in bitter taste preference (p=0.186) or political participation (p=0.507). In terms of the continuous gender identity scales, there was no significant correlation between femininity and bitter taste preference (r=0.03, p=0.39). However, there was a significant positive correlation between bitter taste preference and masculine gender identity, though the effect size is small (r=0.07, p=0.03), providing some initial support to our expectations that men will prefer bitter tastes.

Hypothesis 1

[1] The sweet (Cronbach's Alpha = .75), salty (Cronbach's Alpha = .67), and sour (Cronbach's Alpha = .73) scales had similar levels of reliability.

[2] To create the political participation scale, we took the mean of the 9-item Kam measure and the question about posting political content on social media.

In Hypothesis 1, we predicted that bitter taste preference would be positively associated with risk tolerance. To test this hypothesis, we regressed risk tolerance on the bitter taste scale, controlling for age, binary sex, and education. We find strong support for Hypothesis 1. The bitter taste scale was positively associated with risk tolerance ($p<.01$). Full results are displayed in Table 1[3] and summarized in Figure 1, demonstrating that the relationship between bitter taste preference and risk tolerance is the same for men and women. With respect to the control variables, age, and being a female respondent were negatively associated with risk tolerance, and education was positively associated with risk tolerance.

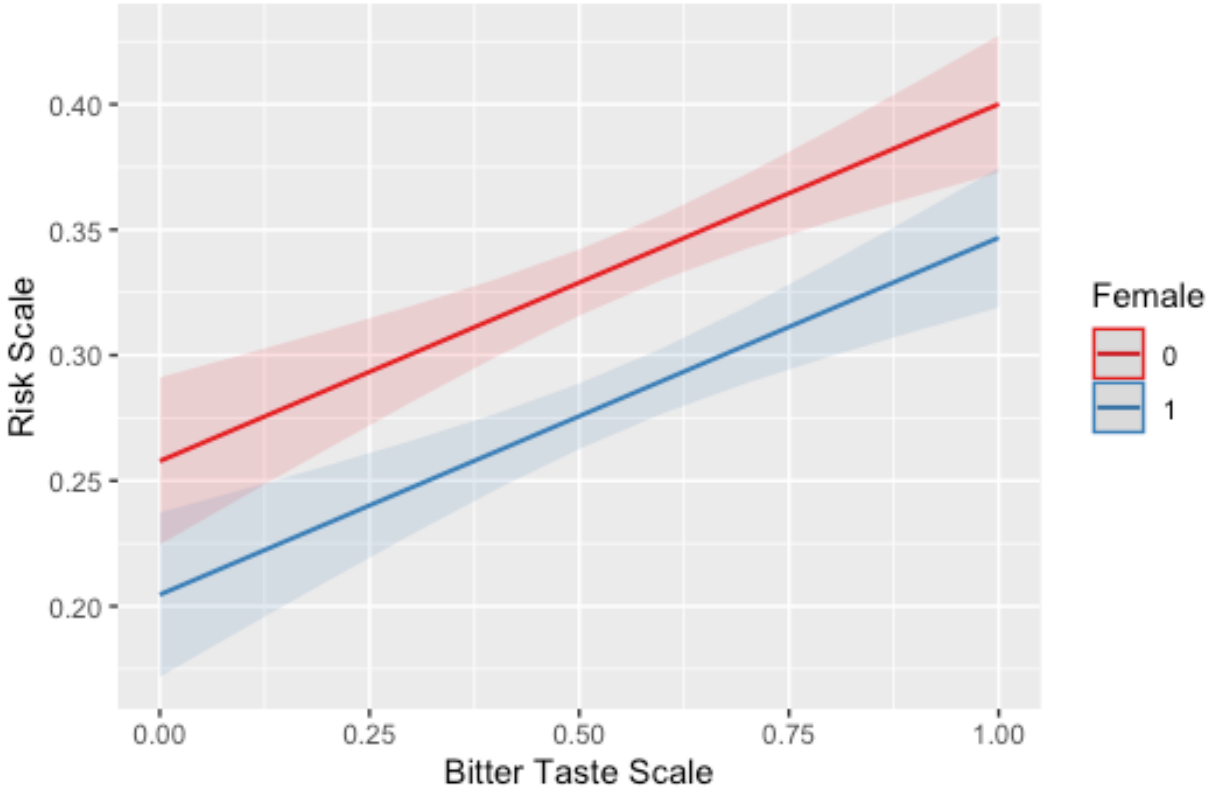
Table 1: Regression Results (Adult Sample – 2020)

	Dependent variable:				
	Risk Scale	Kam Risk Scale	Political Participation		
	(H_1)	(H_1)	(H_2)	(H_3)	(H_4)
Bitter Scale	0.142***	0.217***	0.397***	0.353***	0.252***
	(0.028)	(0.033)	(0.048)	(0.069)	(0.068)
Age	-0.249***	-0.181***	-0.123***	-0.123***	-0.054
	(0.020)	(0.023)	(0.034)	(0.034)	(0.033)
Sex (1=female)	-0.053***	-0.048***	0.0003	-0.046	-0.047
	(0.009)	(0.011)	(0.016)	(0.055)	(0.053)
Kam Risk Scale					0.394***
					(0.044)
Education	0.053***	0.013	0.159***	0.160***	0.155***
	(0.017)	(0.020)	(0.029)	(0.029)	(0.028)
Bitter*Sex				0.083	0.118
				(0.095)	(0.092)
Constant	0.325***	0.457***	0.087***	0.111**	-0.059
	(0.019)	(0.023)	(0.033)	(0.043)	(0.046)

[3] We also ran regression models regressing the Weber risk tolerance sub-scales on the bitter taste scale with the same control variables. Bitter taste preference was positively associated with social risk, recreational risk, and financial risk. These models can be found in the Appendix.

Observations	1,021	1,019	1,008	1,008	1,008
R^2	0.174	0.102	0.102	0.103	0.168
Adjusted R^2	0.170	0.099	0.098	0.098	0.163
Residual Std. Error	0.147 (df = 1016)	0.171 (df = 1014)	0.249 (df = 1003)	0.249 (df = 1002)	0.240 (df = 1001)
F Statistic	53.323*** (df = 4; 1016)	28.916*** (df = 4; 1014)	28.427*** (df = 4; 1003)	22.887*** (df = 5; 1002)	33.593*** (df = 6; 1001)
Note:					*p<0.1; **p<0.05; ***p<0.01

Figure 1: Effect of Bitter Taste Preference on Risk by Binary Sex



Hypothesis 2

Hypothesis 2 predicted that bitter taste preference would be associated with political activities that involve an element of risk, following Kam (2012). To test this hypothesis, we regressed the political participation scale on the bitter taste scale, again controlling for age,

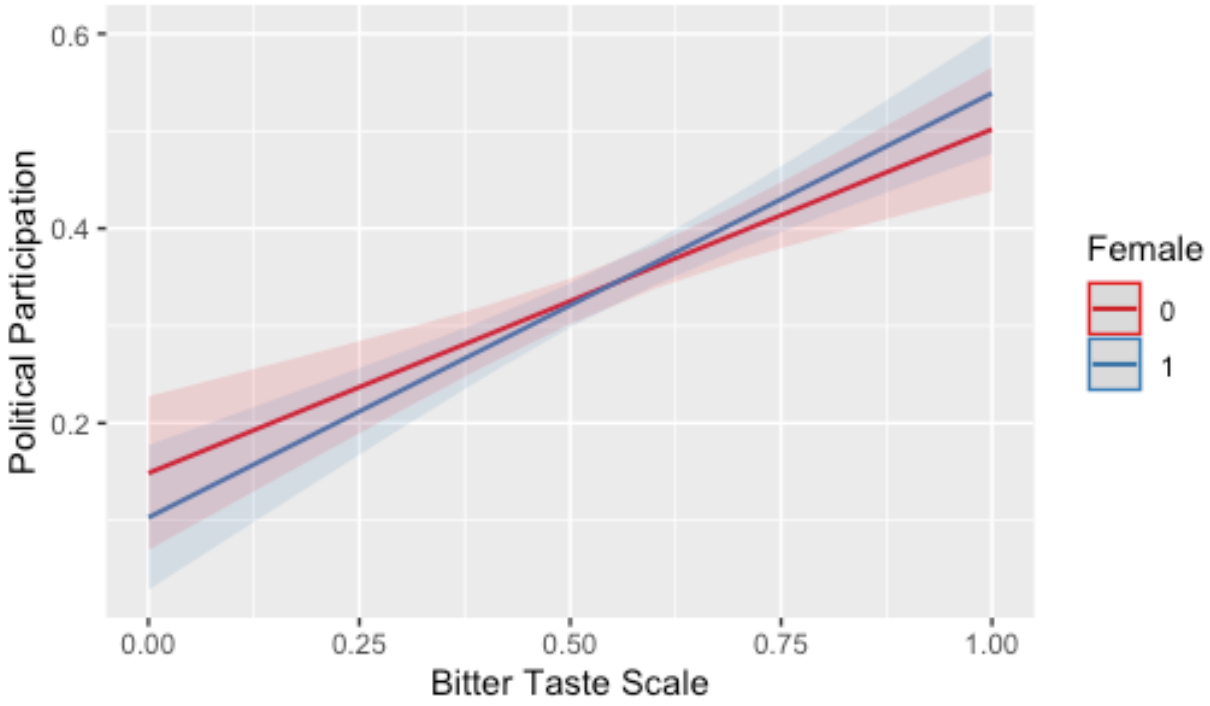
binary sex, and education. Full regression results can be found in Table 1. We find strong support for Hypothesis 2 as bitter taste positively associated with political participation ($p<.01$). With respect to the control variables, age was significantly negatively associated with participation, and education was significantly positively associated with participation. Given this data was collected during a global pandemic arguably effecting older individuals more severely, it may be unsurprising that political participation was lower for older Americans.

Hypothesis 3

In Hypothesis 3, we predicted that women would express a lower preference for bitter flavors and that this would have an effect on willingness to participate in political activities that involve risk. To test the hypothesis, we regressed political participation on the bitter taste scale and an interaction between binary sex and the bitter taste scale. We controlled for age and education. As displayed in Table 1, we find no support for this hypothesis. The interaction between bitter taste preference and sex had no significant effect on political participation. In the second column, we included the Kam (2012) risk scale to determine whether bitter taste preferences were simply a proxy for risk in the relationship with participation, but in fact, bitter taste and risk are accounting for variance separately. The results of this hypothesis are summarized in Figure 2, which shows that the effect of bitter taste on political participation does not differ by binary sex. We also conducted a mediation analysis to see if bitter taste mediates the relationship between binary sex and political participation. The typical procedure for conducting a mediational analysis is a four-step method in which a series of linear regressions models are fitted to estimate the relationship between the independent and dependent variables controlling for the mediational variable (Baron and Kenny 1986). We expected that bitter taste preference would attenuate the effect of female sex on political participation. Full mediation

would occur if the effect of sex on political participation reduces to zero with the inclusion of bitter taste preference in the model. Partial mediation would occur if the effect were reduced. We followed this procedure and found that bitter taste preference does not mediate the relationship between binary sex and political participation. We also conducted a Sobel test and found no evidence of a mediation effect (p=0.19).

Figure 2: Effect of Bitter Taste Preference on Political Participation by Binary Sex



Hypothesis 4

In our final hypothesis, we predicted that bitter taste preference would mediate the relationship between continuous measures of gender identity and political participation. We followed the same procedure that we followed to test H_3 and found that bitter taste preference does not mediate the relationship between feminine gender identity and political participation. We also conducted a Sobel test and found no evidence of a mediation effect (p=0.39).

Study 2 (Student Sample – Spring 2019)

As for Study 1, we first discuss descriptive statistics of the sample and scale reliabilities, followed by the models described in the pre-registered analysis strategy. The food preference data in this sample were collected prior to pre-registration and should be considered as pilot data. The PROP data were collected after pre-registration. All significance tests are two-tailed.

The central variables of interest in this study are bitter taste preferences, risk tolerance, categorical gender identity, continuous gender identity, and interest in politics; political participation was not available in this sample. 46.2% of the sample identified as male, 53.1% as female, and 0.8% as non-binary ("What is your gender identity?"). When asked about their gender identity ("Finally, we would like to ask you a question about your gender identity. That is, how masculine or feminine you feel you are. Below you will find a continuum that goes from left to right. We would like you to place yourself somewhere along this scale: the far right of the scale reflects a person who feels they are 100% masculine, while the far left of the scale reflects a person who feels they are 100% feminine. Where would you place yourself on this continuum?"), among male respondents 19.8% rate themselves as fully masculine and among female respondents 20.7% rate themselves as fully feminine. To create a bitter food taste preference scale, we took the mean of all the bitter taste items we asked participants to rate ($\bar{x}$ = 0.53, Cronbach's alpha = .68). The bitter taste subscale had the lowest average score in terms of taste preference compared to the sweet ($\bar{x}$ = 0.71), salty ($\bar{x}$ = 0.63), and sour ($\bar{x}$ = 0.58) taste subscales. We conducted the same procedure to create risk tolerance scales (Kam 2012 Scale: $\bar{x}$ = 0.49, Cronbach's alpha = .56; Weber et al. 2002 Scale: $\bar{x}$ = 0.43, Cronbach's alpha = .86) and two-item measure of interest in politics in lieu of the political participation index ($\bar{x}$ = 0.35, Cronbach's alpha = .56). For PROP tasting, 37.2% of the sample were non-tasters (i.e., they

categorized the intensity difference between the control and PROP strip as zero or less, or they characterized the taste of the PROP strip as not bitter). There was an average difference in the ratings of taste intensity between the PROP strip and control strip of 0.17 (0.28 among tasters only). Compared to men, women were significantly more likely to be tasters (men = 57.0%, women = 71.6%, $p = 0.003$), to have stronger difference ratings compared to control (men = 0.12, women = 0.23, $p < 0.001$), and to have stronger difference ratings among tasters (men = 0.22, women = 0.32, $p < 0.001$). In terms of other demographic variables, of those reporting race, our sample is 58.0% non-Hispanic White, 7.5% Black, 14.6% Asian, 1.0% other race, 8.5% multiracial, and 14.3% Hispanic or Latino. The sample has a mean age of 20.0. Full demographic information can be found in the Appendix.

Based on a two-sample t-test, we found no significant gender differences in bitter taste preference ($mean_{women} = 0.53$, $mean_{men} = 0.52$, $p=0.299$), and that women in our sample are significantly more interested in politics than men ($mean_{women} = 0.39$, $mean_{men} = 0.31$, $p<0.001$). In terms of the continuous gender identity, there was no significant correlation with bitter taste preference ($r=-0.02$, $p=0.59$).

Hypothesis 1

In Hypothesis 1, we predicted that bitter taste preference would be positively associated with risk tolerance. To test this hypothesis, we regressed risk tolerance on the bitter taste scale. We controlled for age and gender identity (not for education, as the sample consists of college students). We again find strong support for Hypothesis 1. The bitter taste scale was positively associated with risk tolerance ($p<.01$). Full results are displayed in Tables 2 and 3.[4] Figure 3

[4] We also ran regression models regressing the Weber risk tolerance sub-scales on the bitter taste scale with the same control variables. Bitter taste preference was positively associated with social risk, recreational risk, ethical risk, and investment risk. These models can be found in the Appendix.

shows the predicted effect of bitter taste preference on risk tolerance. With respect to the control variables, identifying as female were negatively associated with risk tolerance across both measures and older participants were less risk seeking on the Weber measure.

The results for PROP tasting do not follow Hypothesis 1, which predicted that PROP tasting would be associated with lower levels of risk taking; there is no significant relationship between PROP tasting and either measure of risk. PROP tasting is significantly related with less risk seeking on the Weber social risk subscale (see Appendix).

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

Table 2: Regression Results for Bitter Taste Preference (Student Sample – 2019)

	Dependent variable:				
	Weber Risk	Kam Risk	Interest in Politics		
	(H_1)	(H_1)	(H_2)	(H_3)	(H_3)
Bitter Taste	0.146***	0.199***	-0.113	-0.184*	-0.173*
	(0.033)	(0.052)	(0.075)	(0.104)	(0.105)
Age	-0.083*	-0.009	0.173	0.174*	0.173*
	(0.046)	(0.073)	(0.105)	(0.105)	(0.105)
Gender (Women)	-0.046***	-0.034**	0.091***	0.012	0.011
	(0.010)	(0.016)	(0.023)	(0.082)	(0.083)
Kam risk					-0.052
					(0.063)
Gender (non-cis)	-0.087	-0.005	0.198	0.198	0.198
	(0.056)	(0.089)	(0.129)	(0.129)	(0.129)
Bitter taste * Gender (Women)				0.150	0.148
				(0.150)	(0.150)
Constant	0.389***	0.402***	0.332***	0.369***	0.390***
	(0.021)	(0.033)	(0.048)	(0.061)	(0.066)
Observations	521	521	521	521	521
R^2	0.077	0.035	0.039	0.041	0.042
Adjusted R^2	0.070	0.027	0.031	0.031	0.031
Residual Std. Error	0.111 (df = 516)	0.177 (df = 516)	0.255 (df = 516)	0.255 (df = 515)	0.255 (df = 514)
F Statistic	10.765*** (df = 4; 516)	4.640*** (df = 4; 516)	5.206*** (df = 4; 516)	4.363*** (df = 5; 515)	3.745*** (df = 6; 514)
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 3: Regression Results for PROP Taste Sensitivity (Student Sample – 2019)

	Dependent variable:				
	Weber Risk	Kam Risk	Interest in Politics		
	(H_1)	(H_1)	(H_2)	(H_3)	(H_3)
PROP Taste	-0.009	0.008	-0.099	-0.205*	-0.202*
	(0.027)	(0.045)	(0.066)	(0.122)	(0.122)
Age	-0.049	0.048	0.135	0.135	0.139
	(0.052)	(0.086)	(0.125)	(0.125)	(0.125)
Gender (Women)	-0.033***	-0.015	0.119***	0.096***	0.095***
	(0.012)	(0.019)	(0.028)	(0.036)	(0.036)
Kam risk					-0.077
					(0.076)
Gender (non-cis)	-0.123**	-0.009	0.204	0.197	0.196
	(0.062)	(0.103)	(0.150)	(0.150)	(0.150)
PROP taste * Gender (Women)				0.150	0.147
				(0.145)	(0.145)
Constant	0.445***	0.472***	0.276***	0.289***	0.325***
	(0.014)	(0.023)	(0.034)	(0.036)	(0.051)
Observations	369	369	369	369	369
R^2	0.032	0.003	0.051	0.054	0.056
Adjusted R^2	0.021	-0.008	0.041	0.041	0.041
Residual Std. Error	0.106 (df = 364)	0.177 (df = 364)	0.258 (df = 364)	0.258 (df = 363)	0.258 (df = 362)
F Statistic	2.990** (df = 4; 364)	0.257 (df = 4; 364)	4.887*** (df = 4; 364)	4.126*** (df = 5; 363)	3.607*** (df = 6; 362)
Note:					*p<0.1; **p<0.05; ***p<0.01

Hypothesis 2

Hypothesis 2 predicted that bitter taste preference would be associated with political activities that involve an element of risk, following Kam (2012). This sample did not have a measure of political participation, but we constructed a measure of interest in politics as a proxy. We controlled for age and gender identity. We found no relationship between interest in politics and either bitter taste preference or PROP taste ability. Women in the sample were significantly more interested in politics than men.

Hypotheses 3 and 4

In Hypothesis 3, we predicted that women would express a lower preference for bitter flavors, and Hypothesis 4 with continuous gender identity, and that this would have an effect on willingness to participate in political activities that involve risk. As noted above, based on a two-sample t-test, we found no significant gender difference in bitter taste preference, but we do find that women are significantly more sensitive to PROP than men (men = 0.12, women = 0.23, $p < 0.001$). To test the hypothesis, we regressed interest in politics on the bitter taste scale (or PROP tasting) and an interaction between categorical gender and the bitter taste scale (or PROP tasting). We controlled for age. Full regression results can be found in Tables 2 and 3. We find no support for this hypothesis. For bitter taste preference, we see a marginal direct effect indicating that for men, bitter taste preference may be associated with lower interest in politics; however, the interaction with gender is not statistically significant. For PROP tasting, the results follow the same pattern – PROP tasting for men has a marginal relationship with lower interest, with no significant interaction. The results of all models remain unchanged by controlling for the Kam (2012) risk scale. We included this control to determine whether bitter taste preferences and PROP tasting were simply a proxy for risk in the relationship with participation, but in fact, the

effects on interest in politics are essentially unchanged controlling for risk, and there is no significant effect of risk on interest in politics.

We also conducted a mediation analysis to see if bitter taste mediates the relationship between binary sex and political participation following the same analysis strategy as in the adult sample. Results of the Sobel test indicate that there is no evidence of a mediation effect for bitter food preferences on political interest with either binary sex (Sobel = .39) or continuous gender identity (Sobel = .61). There is an effect with PROP detection, however, such that the effect of gender and binary sex, tested in separate models, *increases* once PROP detection is included (Sobel = .002 for both). This demonstrates evidence of a possible suppressor effect and no mediation.

Study 3 (Student Sample – Fall 2020)

The central variables of interest in this study are bitter taste preferences, risk tolerance, sex, gender identity, and political participation. 42.3% of the sample identified as male, 55.4% as female, and 2.3% did not answer the sex assigned at birth question. Among male respondents, 22.2% rate themselves at the highest end of the masculinity scale and among female respondents, 22.2% rate themselves on the highest end of the femininity scale. To create a bitter taste preference scale, we took the mean of all the bitter taste items we asked participants to rate ($\bar{x}$ = 0.51, Cronbach's alpha = .67). The bitter taste subscale had the lowest average score in terms of taste preference compared to the sweet ($\bar{x}$ = 0.71), salty ($\bar{x}$ = 0.63), and sour ($\bar{x}$ = 0.56) taste subscales. We conducted the same procedure to create risk tolerance scales (Kam 2012 Scale: $\bar{x}$ = 0.47, Cronbach's alpha = .74; Weber et al. 2002 Scale: $\bar{x}$ = 0.52, Cronbach's alpha = .86) and the same political participation index as in Study 1 ($\bar{x}$ = 0.53, Cronbach's alpha = .91). For PROP tasting, 56.0% of the sample were non-tasters (i.e., they categorized the intensity

difference between the control and PROP strip as zero or less, or they characterized the taste of the PROP strip as not bitter). There was an average difference in the ratings of taste intensity between the PROP strip and control strip of 0.14 (0.33 among tasters only). Compared to males, females were significantly more likely to be tasters (men = 32.5%, women = 53.4%, p = 0.041), to have stronger difference ratings compared to control (men = 0.07, women = 0.20, p = 0.003), and to have stronger difference ratings among tasters (men = 0.21, women = 0.37, p = 0.024). In terms of other demographic variables, of those reporting race, our sample is 53.1% non-Hispanic White, 6.2% Black, 0.27% American Indian, Native American, or Alaska Native, 17.6% Asian, 0.27% Native Hawaiian or Pacific Islander, 10.3% Other (predominantly self-identifying as Latino/a or Hispanic), 4.3% mixed race, and 19.6% Latinx. The sample has a mean age of 20.1. Full demographic information can be found in the Appendix.

Hypothesis 1

In Hypothesis 1, we predicted that bitter taste preference would be positively associated with risk tolerance and that PROP sensitivity would be negatively associated with risk tolerance. To test this hypothesis, we regressed risk tolerance on the bitter taste scale and PROP sensitivity. We controlled for age and binary sex, but not education (as the sample is all college students). We find no support for Hypothesis 1. Full results are displayed in Tables 4 and 5.[5] Female respondents were lower in risk on the Weber scale, but not the Kam scale.

[5] We also ran regression models regressing the Weber risk tolerance sub-scales on the bitter taste scale with the same control variables. Bitter taste preference was positively associated with social risk and recreational risk. These models can be found in the Appendix.

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

Table 4: Regression Results for Bitter Taste Preference (Student Sample – 2020)

	Dependent variable:				
	Weber Risk	Kam Risk	Political Participation		
	(H_1)	(H_1)	(H_2)	(H_3)	(H_3)
Bitter Taste	0.063	0.084	0.020	-0.123	-0.135
	(0.058)	(0.058)	(0.081)	(0.118)	(0.117)
Age	-0.018	0.049	-0.141	-0.135	-0.142
	(0.118)	(0.118)	(0.165)	(0.165)	(0.164)
Female	-0.046**	-0.023	0.153***	0.014	0.018
	(0.018)	(0.018)	(0.025)	(0.086)	(0.086)
Kam risk					0.141*
					(0.073)
Gender (non-cis)	-0.013	-0.098**	0.037	0.029	0.043
	(0.050)	(0.050)	(0.070)	(0.070)	(0.070)
Bitter taste * Female				0.271*	0.271*
				(0.162)	(0.161)
Constant	0.518***	0.441***	0.439***	0.511***	0.449***
	(0.032)	(0.032)	(0.045)	(0.063)	(0.070)
Observations	374	374	374	374	374
R^2	0.021	0.021	0.095	0.102	0.111
Adjusted R^2	0.010	0.011	0.085	0.090	0.096
Residual Std. Error	0.170 (df = 369)	0.169 (df = 369)	0.238 (df = 369)	0.237 (df = 368)	0.236 (df = 367)
F Statistic	1.967* (df = 4; 369)	2.002* (df = 4; 369)	9.670*** (df = 4; 369)	8.337*** (df = 5; 368)	7.633*** (df = 6; 367)
Note:					*p<0.1; **p<0.05; ***p<0.01

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

Table 5: Regression Results for PROP Taste Sensitivity (Student Sample – 2020)

	Dependent variable:				
	Weber Risk	Kam Risk	Political Participation		
	(H_1)	(H_1)	(H_2)	(H_3)	(H_3)
PROP sensitivity	0.088	0.075	0.114	0.264	0.213
	(0.083)	(0.093)	(0.108)	(0.308)	(0.307)
Age	-0.039	0.078	0.019	0.010	-0.002
	(0.147)	(0.166)	(0.192)	(0.193)	(0.192)
Female	-0.025	-0.050	0.196***	0.212***	0.217***
	(0.037)	(0.042)	(0.048)	(0.057)	(0.056)
Kam risk					0.187
					(0.120)
Gender (non-cis)	0.012	-0.008	0.043	0.027	0.032
	(0.087)	(0.098)	(0.114)	(0.118)	(0.117)
PROP sensitivity * Female				-0.172	-0.129
				(0.329)	(0.328)
Constant	0.530***	0.463***	0.440***	0.430***	0.346***
	(0.028)	(0.032)	(0.037)	(0.041)	(0.068)
Observations	98	98	98	98	98
R^2	0.016	0.018	0.201	0.204	0.224
Adjusted R^2	-0.026	-0.024	0.167	0.160	0.173
Residual Std. Error	0.170 (df = 93)	0.191 (df = 93)	0.221 (df = 93)	0.222 (df = 92)	0.220 (df = 91)
F Statistic	0.381 (df = 4; 93)	0.434 (df = 4; 93)	5.861*** (df = 4; 93)	4.707*** (df = 5; 92)	4.389*** (df = 6; 91)
Note:					*p<0.1; **p<0.05; ***p<0.01

Hypothesis 2

Hypothesis 2 predicted that bitter taste preference would be positively associated with political activities that involve an element of risk, following Kam (2012), and that PROP sensitivity would have the opposite relationship. To test this hypothesis, we regressed the political participation scale on the bitter taste scale and PROP sensitivity separately. We controlled for age and binary sex. We do not find support for Hypothesis 2. The bitter taste scale and PROP sensitivity were not significantly associated with political participation. With respect to the control variables, female participants were more likely to participate in politics.

Hypotheses 3 and 4

In Hypothesis 3, we predicted that women would express a lower preference for bitter flavors, and Hypothesis 4 with continuous gender identity, and that this would have an effect on willingness to participate in political activities that involve risk. As noted above, based on a two-sample t-test, we found no significant gender difference in bitter taste preference but the expected difference in PROP sensitivity. To test the hypothesis, we regressed interest in politics on the bitter taste scale (or PROP tasting) and an interaction between binary sex and the bitter taste scale (or PROP tasting). We controlled for age. Full regression results can be found in Tables 4 and 5. We find a marginally significant interaction effect for bitter taste sensitivity. The results indicate that for women, greater bitter taste preference may be associated with more participation in politics relative to men. We find no significant main effect or interaction for PROP. As expected, greater risk seeking predicts greater participation in politics.

We also conducted a mediation analysis to see if bitter taste mediates the relationship between binary sex and political participation following the same analysis strategy as in the adult sample. Results of the Sobel test indicate that there is no evidence of a mediation effect for bitter

food preferences on political interest with binary sex (Sobel = .93), femininity (Sobel = .98), or masculinity (Sobel = .65). Similarly, we find no evidence for a mediating effect of PROP taste sensitivity for binary sex (Sobel = .20), femininity (Sobel = .30), or masculinity (Sobel = .20), although the PROP sample is much smaller than in Study 2 (N = 98 compared to N = 366).

Discussion

Within our nationwide sample of American adults, we find strong support that those who have a higher degree of preference for bitter tastes also tend to be more risk tolerant. In addition, bitter taste preference was positively associated with political participation, particularly those activities that involve social risk (Kam, 20120. Contrary to our expectations, the relationship between bitter taste and political participation was not conditional on gender. In fact, higher masculine *and* higher feminine identification predicted more political participation. When we look at this effect within an individual's self-reported binary sex, masculinity is positively associated with participation among women ($r = .19$, $p < .001$), and femininity with participation among men ($r = .25$, $p < .001$). Building on the growing evidence of gender identity's effects on politics (Bittner and Goodyear-Grant, 2017; Gidengil and Stolle, 2020; Gidengil and Stolle, 2021), future research should examine why these sex atypical gender identities are predictive of political engagement.

In our 2019 student sample, bitter food preferences were associated with more risk tolerance, but this effect did not extend to detection of the PROP strip taste. PROP detection and the bitter food ratings were not related to political interest at the $p < 0.05$ level and this relationship did not significantly differ by gender. There was weak evidence (at the $p < 0.10$ level) that bitter taste preference and PROP sensitivity may be predictive of lower interest in politics among men when the gender interaction was included in the model. Moving to the 2020

student sample, where PROP was collected at home via mail, neither PROP or the bitter food preferences were associated with risk or political participation. We did find that for women, greater bitter taste preference may be associated with more political participation relative to men. This mixed pattern of results may point to general differences in more representative, adult versus student samples, including food taste, risk, and rates of participation. Or perhaps the effects we detect with food preferences in two of the three samples are more predictive of socialized bitter food-seeking rather than a biological ability to detect the PROP strip. A third possibility is that the relationships of political orientations with taste preferences and genetically influenced taste abilities may only emerge later in early to mid-adulthood, perhaps through a process of niche selection as people have more control over their environments.

We acknowledge several limitations to our study. Due to economic and COVID-19 related constraints, we were only able to analyze PROP detection within a student sample that also had many at-home participants rather than the strict protocol of the lab. This data was also collected during a global pandemic during a contentious U.S. presidential election where risk tolerance, political participation, and even food preferences could be impacted. Thus, we are certainly cautious in our interpretations, but we think this research helps move the conversation forward regarding the connections between biology and politics. Our studies cannot speak to causality, but future research should continue to explore the genetic, physiological, and environmental connections between these variables of interest.

Contributing one more correlate of democratic engagement may seem only of scholarly use, but we would argue that investigating the biological and life preference connections to political involvement helps illustrate a broader picture of public life. That is, politics is merely another element in an individual's environment that is impacted by instincts, dispositions,

socialization, and context. People who take risks are more likely to engage in politics (Kam 2012) and more likely to try and enjoy a wider variety of foods, making politics as much an "experience" as a diligent exercise in citizenship. Including both PROP detection and self-reported food preferences provide leverage on understanding how much of the effect on risk and politics may be biological or culturally learned. We know that individuals develop tastes for substances like coffee over their life course, but the variation in taste-related genetic markers and anatomy of our taste buds suggest there may be a limit on overriding our biology.

Gender differences across risk tolerance, taste preferences, and political engagement suggest that women may have evolved and be socialized to exercise restraint and caution. On the flip side, trying new foods, taking risks, and getting political involved have benefits that may be missed by those shying away from the possibility of unpleasantness or danger. Indeed, some psychologists argue that more risk taking can increase excitement and life satisfaction, and this process could be facilitated through our taste buds. In a series of experiments in two different cultures, Vi and Obrist (2018) found that ingestion of sour tastes led to the highest level of risk-taking behavior when compared to bitter, salty, sweet, and umami tastes. Interestingly, sweet tastes – which have been linked to pro-social behavior and agreeableness – led to lower levels of risk taking, consistent with our theoretical argument about gender differences in all these domains. Bitter and salty tastes had no effect on risk taking (Vi and Obrist 2018). Taken with our findings, particularly with the non-food taste of PROP and extant literature on its genetic receptor, future research should include investigations of the malleability and habituation of taste preferences and whether these connections to risk-taking persist across time.

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

References

Albers, C. & Läkens, D. (2018). When power analyses based on pilot data are biased: Inaccurate effect size estimators and follow-up bias. *Journal of Experimental Social Psychology, 74*, 187-195.

Bachmanov, A. A., & Beauchamp, G. K. (2007). Taste receptor genes. *Annual Review of Nutrition*, *27*, 389-414.

Bartoshuk, L. M., Duffy, V. B., & Miller, I. J. (1994). PTC/PROP tasting: anatomy, psychophysics, and sex effects. *Physiology & behavior*, *56*(6), 1165-1171.

Bem, S.L. (1976). Sex typing and androgyny: Further explorations of the expressive domain. *Journal of Personality and Social Psychology*, 34, 1016.

Bembich, S., Lanzara, C., Clarici, A., Demarini, S., Tepper, B. J., Gasparini, P., & Grasso, D. L. (2010). Individual differences in prefrontal cortex activity during perception of bitter taste using fNIRS methodology. *Chemical senses*, *35*(9), 801-812.

Bittner, A., & Goodyear-Grant, E. (2017). Sex isn't gender: Reforming concepts and measurements in the study of public opinion. *Political Behavior, 39*(4), 1019-1041.

Bord, R. J., & O'Connor, R. E. (1997). The gender gap in environmental attitudes: The case of perceived vulnerability to risk. *Social science quarterly*, 830-840.

Byrnes, N. K. & Hayes, J. E. (2016). Behavioral measures of risk tasking, sensation seeking and sensitivity to reward may reflect different motivations for spicy food liking and consumption. *Appetite* 103, 411–422.

Burns, N., Schlozman, K.L., & Verba, S. (2001). The private roots of public action. Harvard University Press.

Conway, L. G., III, Woodard, S. R., & Zubrod, A. (2020, April 7). Social Psychological Measurements of COVID-19: Coronavirus Perceived Threat, Government Response, Impacts, and Experiences Questionnaires. https://doi.org/10.31234/osf.io/z2x9a

Cowart B.J., Yokomukai Y., Beauchamp G.K. (1994). Bitter taste in aging: Compound-specific decline in sensitivity. *Physiology & Behavior 56*(6):1237-41.

Cross, C. P., Copping, L. T., & Campbell, A. (2011). Sex differences in impulsivity: a meta-analysis. *Psychological bulletin*, *137*(1), 97.

Dawes, C., Cesarini, D., Fowler, J. H., Johannesson, M., Magnusson, P. K. E., & Oskarsson, S. (2014). The relationship between genes, psychological traits, and political participation. American Journal of Political Science, 58, 888– 903

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

Dubovski, N., Ert, E., & Niv, M. Y. (2017). Bitter mouth-rinse affects emotions. *Food quality and preference*, *60*, 154-164.

Duffy, V., Davidson, A.C., Kidd, J.R., Kidd, K.K., Speed, W.C., Pakstis, A.J., et al. (2004). Bitter receptor gene (TAS2R38), 6-n-propylthiouracil (PROP) bitterness and alcohol intake. Alcohol Clin Exp Res 28, 1629–1637.

Djupe, P.A., Friesen, A., and Sokhey, A. n.d. "Understanding Gender and Political Participation: Assessing the Relationship between Networks and Dispositions." Presented at the 2017 Annual Meeting of the Midwest Political Science Association.

Finucane, M. L., Slovic, P., Mertz, C. K., Flynn, J., & Satterfield, T. A. (2000). Gender, race, and perceived risk: The 'white male' effect. *Health, risk & society*, *2*(2), 159-172.

Flynn, J., Slovic, P., & Mertz, C. K. (1994). Gender, race, and perception of environmental health risks. *Risk analysis*, *14*(6), 1101-1108.

Fowler, J., Baker, L., & Dawes, C. (2008). Genetic Variation in Political Participation. *American Political Science Review*, *102*(2), 233-248. doi:10.1017/S0003055408080209

Friesen, A., Gruszczynski, M., Smith, K. B., & Alford, J. R. (2020). Political attitudes vary with detection of androstenone. *Politics and the Life Sciences*, *39*(1), 26-37.

Friesen, A. & Djupe, P. (2017). Conscientious women: The dispositional conditions of institutional treatment on civic involvement. *Politics & Gender 13*(1), 57-80.

Garbarino, E., and Strahilevitz, M. (2004). Gender Differences in the Perceived risk of Buying Online and the Effects of Receiving a Site Recommendation. *Journal of Business and Research*, 57 (7), 768-775.

Gerber, A. S., Huber, G. A., Doherty, D., Dowling, C. M., Raso, C., & Ha, S. E. (2011). Personality traits and participation in political processes. *The Journal of Politics*, *73*(3), 692-706.

Gidengil, E., & Stolle, D. (2020). Comparing self-categorisation approaches to measuring gender identity. *European Journal of Politics and Gender*.

Gidengil, E., & Stolle, D. (2021). Comparing self-categorisation approaches to measuring gender identity. *European Journal of Politics and Gender*, *4*(1), 31-50.

Hatemi, P. K., McDermott, R., Bailey, J. M., & Martin, N. G. (2012). The different effects of gender and sex on vote choice. *Political Research Quarterly*, *65*(1), 76-92.

Hayes JE, Bartoshuk LM, Kidd JR, Duffy VB. (2008). Supertasting and PROP bitterness depends on more than the TAS2R38 gene. *Chem. Senses*, 33, 255–65

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

Herz, R. (2007). *The Scent of Desire: Discovering Our Enigmatic Sense of Smell*. New York: William Morrow.

Hibbing, J.R., Smith, K.B. and Alford, J.R. (2013). *Predisposed: Liberals, conservatives, and the biology of political differences*. Routledge.

Higgs, S., Cooper, A, Lee, J., and Harris, M. (2015). *Biological Psychology*. London, U.K.: Sage.

Hwang, L. D., Breslin, P. A., Reed, D. R., Zhu, G., Martin, N. G., & Wright, M. J. (2016). Is the association between sweet and bitter perception due to genetic variation?. *Chemical senses*, *41*(9), 737-744.

Joseph, P. V., Reed, D. R., & Mennella, J. A. (2016). Individual differences among children in sucrose detection thresholds: relationship with age, gender, and bitter taste genotype. *Nursing Research*, *65*(1), 3.

Kam, C.D. (2012). Risk attitudes and political participation. *American Journal of Political Science, 56*(4), 817-836.

Kam, C.D. & Simas, E. (2012). Risk attitudes, candidate characteristics, and vote choice. *Public Opinion Quarterly, 76*(4), 747-760.

Karlsson Linnér, R., Biroli, P., Kong, E., Meddens, S., Wedow, R., Fontana, M. A., Lebreton, M., Tino, S. P., Abdellaoui, A., Hammerschlag, A. R., Nivard, M. G., Okbay, A., Rietveld, C. A., Timshel, P. N., Trzaskowski, M., Vlaming, R., Zünd, C. L., Bao, Y., Buzdugan, L., Caplin, A. H., … Beauchamp, J. P. (2019). Genome-wide association analyses of risk tolerance and risky behaviors in over 1 million individuals identify hundreds of loci and shared genetic influences. *Nature genetics*, *51*(2), 245–257. https://doi.org/10.1038/s41588-018-0309-3

Keller KL, Steinmann L, Nurse RJ, Tepper BJ. (2002) Genetic taste sensitivity to 6-n-propylthiouracil influences food preference and reported intake in preschool children. *Appetite*; 38, 3–12

Klemmensen, R. Hatemi, P. Hobolt, S. Petersen, I. Skytthe, A. & Nørgaard, A. (2012). The genetics of political participation, civic duty, and political efficacy across cultures: Denmark and the United States. *Journal of Theoretical Politics, 24*.

Kraemer H.C., Mintz J., Noda A., Tinklenberg J., & Yesavage J.A. (2006). Caution regarding the use of pilot studies to guide power calculations for study proposals. *Arch Gen Psychiatry, 63*(5), 484-489.

Macht, M., & Mueller, J. (2007). Increased negative emotional responses in PROP supertasters. *Physiology & behavior*, *90*(2-3), 466-472.

McDermott, M.L. (2016). *Masculinity, Femininity, and American Political Behavior*. Oxford: Oxford University Press.

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

Meier, B. Moeller, S., Riemer-Peltz, M. & Robinson, M. (2011). Sweet Taste Preferences and Experiences Predict Prosocial Inferences, Personalities, and Behaviors. *Journal of personality and social psychology*, 102, 163-74.

Mondak, J., Hibbing, M., Canache, D., Seligson, M., & Anderson, M. (2010). "Personality and Civic Engagement: An Integrative Framework for the Study of Trait Effects on Political Behavior." *American Political Science Review, 104*(1), 85-110. doi:10.1017/S0003055409990359

McDermott, R., Tingley, D., & Hatemi, P. K. (2014). Assortative mating on ideology could operate through olfactory cues. *American Journal of Political Science*, *58*(4), 997-1005.

Meier, B. P., Moeller, S. K., Riemer-Peltz, M., & Robinson, M. D. (2012). Sweet taste preferences and experiences predict prosocial inferences, personalities, and behaviors. *Journal of Personality and Social Psychology*, *102*(1), 163.

Mennella, J. A., Pepino, M. Y., & Reed, D. R. (2005). Genetic and environmental determinants of bitter perception and sweet preferences. *Pediatrics*, *115*(2), e216-e222.

Mutz, D. (2006). Hearing the other side: Deliberative versus participatory democracy. Cambridge University Press.

Ong, J.S., Hwang, D.L.D., Zhong, V.W., An, J., Gharahkhani, P., Breslin, P.A., Wright, M.J., Lawlor, D.A., Whitfield, J., MacGregor, S., and Martin, N.G. (2018). Understanding the role of bitter taste perception in coffee, tea, and alcohol consumption through Mendelian randomization. *Scientific reports*, *8*(1), p.16414.

Ruisch, B. C., Anderson, R. A., Inbar, Y., & Pizarro, D. A. (in press). A matter of taste: Gustatory sensitivity shapes political ideology. *Journal of Personality and Social Psychology*. Paper available here: http://benruisch.com/wp-content/uploads/2019/02/Manuscript_Taste_and_Ideology.pdf

Sagioglou, C., & Greitemeyer, T. (2014). Bitter taste causes hostility. *Personality and Social Psychology Bulletin*, *40*(12), 1589-1597.

Sagioglou, C., & Greitemeyer, T. (2016). Individual differences in bitter taste preferences are associated with antisocial personality traits. *Appetite*, *96*, 299-308.

Schienle, A., Giraldo, M., Spiegl, B., & Schwab, D. (2017). Influence of Bitter Taste on Affective Facial Processing: An ERP Study. *Chemical Senses*, *42*(6), 473-478.

Schneider, M. C., Holman, M. R., Diekman, A. B., & McAndrew, T. (2016). Power, conflict, and community: How gendered views of political power influence women's political ambition. *Political Psychology*, *37*(4), 515-531.

Friesen, A., Ksiazkiewicz, A., & Gothreau, C. (2021). Political taste: Exploring how perception of bitter substances may reveal risk tolerance and political preferences. *Politics and the Life Sciences*, *40*(2), 152-171.

Schreiber, D., Fonzo, G., Simmons, A. N., Dawes, C. T., Flagan, T., Fowler, J. H., & Paulus, M. P. (2013). Red brain, blue brain: Evaluative processes differ in Democrats and Republicans. *PLoS one*, *8*(2), e52970.

Stein, L. J., Nagai, H., Nakagawa, M., & Beauchamp, G. K. (2003). Effects of repeated exposure and health-related information on hedonic evaluation and acceptance of a bitter beverage. *Appetite*, *40*(2), 119-129.

Sweet-Cushman, J. (2016). Gender, risk assessment, and political ambition. *Politics and the Life Sciences*, *35*(2), 1-17.

Tepper, B. J. (2008). Nutritional implications of genetic taste variation: the role of PROP sensitivity and other taste phenotypes. *Annual Review of Nutrition*, *28*, 367-388.

Tezcür, G.M. (2016). Ordinary people, extraordinary risks: Participation in an ethnic rebellion. *American Political Science Review*, *110*(2), 2470-264.

Trivedi, B. P. (2012). Neuroscience: hardwired for taste. *Nature* 486, 7–9.

Waldron, I., McCloskey, C., & Earle, I. (2005). Trends in gender differences in accidents mortality: Relationships to changing gender roles and other societal trends. *Demographic research*, *13*, 415-454.

Wolak, J. & McDevitt, M. (2011). The roots of the gender gap in political knowledge in adolescence. *Political Behavior*, *33*, 505-533.

Wolak, J. (2020). Self-confidence and gender gaps in political interest, attention, and efficacy. *Journal of Politics*, *82*(4).

Vi, C.T., Obrist, M. (2018). Sour Promotes Risk-Taking: An Investigation into the Effect of Taste on Risk-Taking Behaviour in Humans. *Sci Rep* 8, 7987.