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RESEARCH ARTICLE

Differential brain activations between Democrats and Republicans when considering food purchases

Amanda S. Bruce[1], John M. Crespi[2], Dermot J Hayes[3], Angelos Lagoudakis[4], Jayson L. Lusk[5], Darren M. Schreiber[6] and Qianrong Wu[7]

[1]Associate Professor, Department of Pediatrics, University of Kansas Medical Center, Kansas City, Kansas, USA; [2]Director, Center for Agricultural & Rural Development, Professor, Department of Economics, Iowa State University, Ames, IA, USA; [3]Professor of Economics, Iowa State University, Ames, IA, USA; [4]Graduate Student, Department of Economics, Iowa State University, Ames, IA, USA; [5]Regents Professor and Vice President and Dean of the Division of Agricultural Sciences and Natural Resources, Oklahoma State University, Stillwater, OK, USA; [6]Senior Lecturer in Politics, University of Exeter, Exeter, UK and [7]AirBnB, San Francisco, California, USA

Corresponding author: Darren M. Schreiber; Email: darren.schreiber@gmail.com

Abstract

We measured brain activity using a functional magnetic resonance imaging (fMRI) paradigm and conducted a whole-brain analysis while healthy adult Democrats and Republicans made non-hypothetical food choices. While the food purchase decisions were not significantly different, we found that brain activation during decision-making differs according to the participant's party affiliation. Models of partisanship based on left insula, ventromedial prefrontal cortex, precuneus, superior frontal gyrus, or premotor/supplementary motor area activations achieve better than expected accuracy. Understanding the differential function of neural systems that lead to indistinguishable choices may provide leverage in explaining the broader mechanisms of partisanship.

Keywords: fMRI; political affiliation; decision-making; food choices; neuropolitics

Introduction

Prior to the 2020 Presidential Election, *TheUpshot* blog for the *New York Times* queried if readers could correctly discern from a photo whether the contents of a refrigerator belonged to a Republican or a Democrat (Keefe, 2020). While some refrigerators were correctly ascribed to a party affiliation more than 80% of the time, the upshot of hundreds of thousands of guesses was that they were accurate a paltry 52% of the time. This is close to a coin toss. Though many aspects of American life and culture are politically polarized, including restaurants and grocery store chains (Wasserman, 2014), the foods that end up in our kitchens do not seem to be.

This project, however, asked whether the mental processes *underlying* food choice differ by political party, while we confirmed that the *actual choices* do not. Because the brain performs uncountable related and unrelated actions using the same neural circuitry, it follows that areas of the brain used for one set of decisions are probably going to be used for other decisions. The growing body of decision-neuroscience, neuroeconomics, and neuropolitics literature supports this (Boyland et al., 2024; Dennison et al., 2022). Fundamental work in neuroscience has shown that animals with different neural circuitry and activations may still engage in the same behaviors and make the same decisions (Marder, 2011).

This study examines if the political affiliation of adults who self-identify as Democrat or Republican differs based on brain activity during a decision unrelated to politics. Using two experiments on food purchases, we show that political parties can be relatively well-differentiated not because of the actual foods purchased but because of brain activity when *making* those purchases. Brain activations in five brain regions diverge by political affiliation during a food purchase. Even though the foods the subjects chose do not differ by party affiliation, the brain activity differences are significant enough to allow us to correctly classify consumers as Republicans or Democrats.

Neuroimaging techniques have allowed scientists to explore brain differences between adults identifying as Republicans and Democrats or conservatives and liberals in socio-political experiments, including face judgment, partisanship, motivated reasoning, political interest, political attitudes, and automatic processing of political preferences (Krastev et al., 2016). For example, Schreiber et al. (2013) show that the brain's evaluation processes in a non-social, non-political, risk-taking experiment are distinct between Republicans and Democrats. Yet, what about day-to-day decisions? Will brain differences that predict political affiliation still exist if the experimental stimulus is something as simple as an apolitical, single-item food purchase?

The field of decision neuroscience has grown recently, with some common brain areas frequently identified to be fundamental for making choices about money, food, and political preferences (Figure 1). The brain regions commonly documented to be associated with political attitudes and behavior are emotional regions, including the amygdala (Gozzi et al., 2010; Kanai et al., 2011; Knutson et al., 2006; Petalas et al., 2024; Rule et al., 2010), insular cortex (Kaplan et al., 2007; Krosch et al., 2021; Schreiber et al., 2013; Westen et al., 2006), anterior cingulate cortex (Amodio et al., 2007; Kanai et al., 2011; Kaplan et al., 2007; Westen et al., 2006), ventromedial prefrontal cortex (vmPFC)(Knutson et al., 2006; Mitchell et al., 2006; Zamboni et al., 2009), dorsomedial prefrontal cortex (dmPFC)(Mitchell et al., 2006; Zamboni et al., 2009), dorsolateral prefrontal cortex (dlPFC)(Kaplan et al., 2007; Kato et al., 2009; Zamboni et al., 2009), ventral striatum (Gozzi et al., 2010; Tusche et al., 2013; Westen et al., 2006; Zamboni et al., 2009),

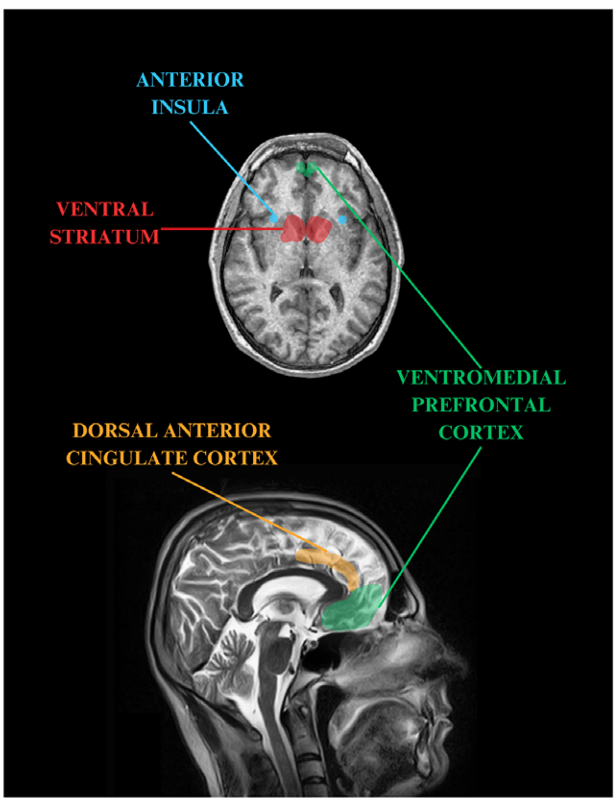


Figure 1. Brain regions commonly activated during decision-making tasks.

and precuneus (Fowler & Schreiber, 2008; Gordon et al., 2019; Kaplan et al., 2016; Moore et al., 2021). Tusche et al. (2013) suggest that partisan bias may operate even in the absence of explicit attention to political content, yet few studies have examined the link between political ideology, brain activity, and non-political content in experiments.

When looking specifically at food, Hibbing et al. (2013) indicated that food preferences may reveal political preferences, Chuck, Fernandes & Hyers (2016) discuss how the politicization of diet can be part of one's social identity and Lusk (2012) shows that there are strong ideological leanings in support of or opposition to a host of food policies. Furthermore, Mosier & Rimal (2020) concluded that Democrats or non-affiliated individuals will report being vegan or vegetarian with a higher probability when compared to Republicans. Our interest is not related to self-reported behavior and revealed *preferences* for food but, as discussed in Sayre (2011), how the *underlying process* of thinking about food reveals political identity.

To identify brain regions most likely to be implicated in decision-making around food, we conducted a meta-analysis of the impact of food advertising upon decision-making in adults and youth, merging data from neuroimaging studies of exposure to food marketing stimuli (versus control) on brain activations in children and adults to clarify relevant brain regions. Eleven studies met inclusion criteria; eight were used for this Activation Likelihood Estimation (ALE) meta-analysis (Eickhoff et al., 2012). Food marketing exposures (versus controls) produced greater activation in two clusters lying across the middle occipital gyrus, lingual gyrus, and cuneus and postcentral gyrus, precentral gyrus, and the inferior parietal lobule/supramarginal gyrus. This meta-analysis demonstrated that brain responses to food advertising are observed in areas relating to visual processing, attention, sensorimotor activity, and emotional processing.

For this study, we examined two sets of healthy adult participants from the United States in separate experiments. One group made food purchase decisions about milk, and the other group made purchase decisions about eggs. The impetus for these food groups was that milk and egg products are so commonly purchased that consumers who purchase them likely have long-established preferences. While previous studies have demonstrated differential brain activation between partisans under conditions of threat, risk, uncertainty, or disgust, the present study demonstrates brain activity differs between Democrats and Republicans during a more mundane and less affectively charged non-political task, food purchasing.

Why brain activity during food purchase decisions might illuminate political identity

The ongoing debate about the nature and origin of mass opinion (Converse, 1964; Zaller, 1992) is undergoing tremendous flux (Carmines & D'Amico, 2015). While there is some argument about the role of elite discourse (Fiorina & Abrams, 2009; Webster & Abramowitz, 2017), polarization (Barber & McCarty, 2016), and affective partisanship (Iyengar et al., 2018; Mason, 2018) as external or top-down influences, the role of internal or bottom-up influences is far more contested.

A wide variety of individual-level or psychological mechanisms have been proposed as explanatory factors in political ideology, including authoritarianism (Adorno, 1950; Feldman & Stenner, 1997), social dominance orientation (Sidanius & Pratto, 1999), motivated social cognition (Jost & Amodio, 2012; Jost et al., 2003), personality (Bakker & Lelkes, 2018; McClosky, 1958), moral foundations (Haidt & Graham, 2007), and values (Rokeach, 1968; Sagiv et al., 2017; Schwartz, 1992). However, it has often been extremely difficult to disentangle these factors from the political context, and in many cases, we find that "foundations" are not playing the role they were expected to play (Hatemi et al., 2019; Hatemi & Verhulst, 2015).

Heritable biological factors have been repeatedly shown to be correlated with political attitudes and behavior (Alford et al., 2005; Hatemi & McDermott, 2012; Smith et al., 2012), however, the mediating factors are less clear (Hatemi & McDermott, 2016; Jost et al., 2014). Initial reports suggested that biometric measures such as skin conductance levels could illuminate the relationship between biology and political attitudes (Oxley et al., 2008). However, recent work has shown these findings do not replicate (Bakker et al., 2020; Osmundsen et al., 2022). The authors of one of these failed replications "urge more, not less, research at the intersection of neuroscience and politics" (Bakker et al., 2020, p. 5).

Brain imaging like functional magnetic resonance imaging (fMRI) may have a particular advantage in this context as fMRI has been shown to be a more powerful predictor of mass behavior beyond self-report than biometrics, implicit association tasks, eye tracking, or electroencephalography (Venkatraman et al., 2015). For instance, brain activity in response to disgusting images enables a highly accurate estimate of a participant's political orientation, with even one single image being sufficient for correct classification (Ahn et al., 2014). Activity associated with the amygdala, in particular, has been shown to differentiate liberals and conservatives as they make risky decisions (Schreiber et al., 2013) or experience the threat of physical pain (Pedersen et al., 2018). The value of brain activity with nonpolitical stimuli as a correlate of political orientation is particularly intriguing and conceptually consistent with results demonstrating differences in brain structure correlating with political identity (Kanai et al., 2011). The structural brain differences exist not only during moments of political activity; thus, it is reasonable that these differences may have implications in nonpolitical contexts.

These differences may be connected to biologically heritable factors, but the predictive power of the functional brain differences goes beyond what we would expect even if genetics were perfectly determining the differences we see in the brain (Schreiber et al., 2013). External factors familiar to traditional political science may be interacting with biological and other influences internal to the individual in order to generate our political attitudes, behaviors, and identities and also alter the structure and function of the brain (Hatemi & McDermott, 2016). The consequence, then, is not a causal story where genes and brains determine politics but rather a view of human nature where politics also shapes our biology (Fowler & Schreiber, 2008; Jost et al., 2014).

Decisions about food provide a particularly fascinating case for investigating the possible interactions between politics and biology. Choices about what to eat are not only frequent but they are often tightly tied to identity, especially when those choices are costly (Henrich, 2009). In his book Collapse, Jared Diamond (2005) cites the example of the Greenland Norse, who died out rather than eating the fish that comprised the diet of their Inuit neighbors. Samuel Popkin (1991) contends that in the context of limited knowledge, voters will often rely on shortcuts in discerning whom to align with, highlighting Gerald Ford's famous error of eating the corn husk around a tamale or George McGovern's mistake of ordering milk with a kosher hot dog. Core values have been shown to be connected with both our food choices (Dreezens et al., 2005) and our political decisions (Schwartz et al., 2014). Preliminary work has tied both our food preferences and political preferences to heritable traits (Hibbing et al., 2013).

Researchers have looked for political differences in measures of both odors (Friesen et al., 2020) and taste perception (Friesen et al., 2021). Intriguingly, there is evidence that sexual mate sorting on ideology may be operating on olfactory cues (McDermott et al., 2014). These smell and taste perceptions can also feed into our view that a particular stimulus is disgusting, with our disgust sensitivity connecting to conservative voting patterns (Shook et al., 2017) and food and health policy attitudes (Clifford & Wendell, 2015) and conservatives avoiding disgusting images (Oosterhoff et al., 2018). Hunger also alters policy decisions among both citizens (Aaroe & Petersen, 2013) and judges (Danziger et al., 2011).

Biological factors such as our genes, brains, sense of smell, and tastes all interact with our identities, affiliations, and political attitudes. Neural mechanisms in tasks not obviously related to politics have nonetheless differentiated partisans and ideologues. The process of food decisions, rather than the decisions themselves, has been argued to reveal political differences (Sayre, 2011). Thus, we set out to investigate whether the neural mechanisms involved in making decisions about food purchases differed between Democrats and Republicans in two experiments.

Two functional brain imaging experiments of food purchase choices

Participants

One hundred healthy, right-handed, English-speaking, non-vegan, non-lactose intolerant adult participants (ages 18–55; mean = 31 years; 49 females) from the Kansas City metropolitan area underwent fMRI scanning at the Hoglund Brain Imaging Center at the University of Kansas Medical Center on a

3-Tesla Skyra (Siemens, Erlangen, Germany) scanner. The study collected political, demographic, biometric, and psychographic information from all participants. Seven participants dropped out during the fMRI scanning. Seventeen participants stated their political affiliation as non-affiliated, and eleven participants as "other" party. Their data was excluded from the primary analysis. In the end, this study analyzed 65 participants, among which 40 were Democrats and 25 were Republicans.

The differences in political affiliation between participants in our study were not driven by sociodemographic characteristics. We tested the equality of means for the sociodemographic variables within all four groups of participants (i.e., self-reported Democrats, Republicans, Independents, and Others) and concluded that there are no significant differences between the different groups regarding gender, age, education, income, and race. This finding corroborates the conclusions of Mosier & Rimal (2020), who demonstrated that gender, education, and race are consistent explanatory factors of self-reported dietary habits across all political affiliations (i.e., Democrats, Republicans, and Unaffiliated). We know of only one brain imaging study that has examined unaffiliated voters (Schreiber et al., 2020) and hope that future studies will also consider comparisons with independent, unaffiliated, or "other" parties.

Two fMRI Experiments

Two separate experiments were performed: a milk-choice experiment and an egg-choice experiment. For the milk experiment, participants underwent fMRI scans and completed 84 non-hypothetical, binary choices between two milk product images labeled with various prices and the production technologies used. Likewise, for the egg experiment, participants underwent fMRI scans and made 84 non-hypothetical, binary choices between two product images of a dozen eggs labeled with prices and production methods. Participants were given \$50 and told that they would be given one of the products they chose during the experiment, with the price of the choice deducted from the payment. In both experiments, participants went home with one of their choices (a gallon of milk or one dozen eggs).

We presented participants with choices where the images showed milk or eggs produced in different ways and at different prices. Specifically, the labels on the images differed according to three experimental conditions for the 84 choices: (a) 28 choices were in the "price condition," in which two products were produced with the same production method, but the prices varied (between \$3 and \$7 in \$0.50 increments in the milk experiment, and between \$0.99 and \$4.99 in \$0.50 increments in the egg experiment); (b) 28 choices were in the "production method condition," in which one of the milk products was labeled as either "from a cloned cow" or using "artificial growth hormone," while the comparative milk was labeled as coming from either a "non-cloned cow" or a cow treated with "no added growth hormone." Likewise, one of the egg products was labeled as coming from hens that were either "caged hens" or "confined hens," and these products were compared with either "cage-free" or "free-range." In the "production method condition," all choices were offered at the same price, and, finally, (c) the remaining 28 choices were in the "combination condition," in which the product with a higher price in the milk experiment was either "non-cloned" or "no added growth hormone" milk while in the eggs experiment, the higher price went to the eggs from hens that were not confined.

The pricing used in the combination condition was chosen because non-confinement practices would raise prices for eggs, but growth hormone or cloning would lower milk prices. The combination experiment is the method considered to be the most realistic, as shoppers must decide upon competing products based on a combination of changing factors. Each choice pair remained on the visual monitor until the participant decided. Following each choice, participants were presented with a confirmation screen indicating which selection they had made. The time to make a decision varied both across and within participants' choices. In order to obtain a consistent image, the confirmation screen was presented no less than 0.5 seconds but no more than 3.5 seconds after the participant made a choice. There were two functional runs in which participants made 42 choices (84 total choices). A fixation cross was presented for 3–15 seconds to jitter the inter-trial interval. The optimal timing of trials was estimated using an Analysis of Functional Neuroimage (AFNI) stimulus timing program (make_random_timing.py) to

Figure 2. Examples of Images from the Milk and the Egg Experiment.

minimize collinearity issues in the fMRI analysis. The order of presentation of choices from the three conditions was randomized in each experiment.

To simulate real shopping behavior, we used images of standard, plastic-gallon jugs for the milk experiment. Milk from cloned cows had been approved by the FDA but was not on the market at the time of data collection. Milk from cows with artificial growth hormone is available but is controversial (Pollack, 2006). In the egg experiment, all the production practices presented to the participants currently exist in the marketplace. We used images of standard one-dozen-sized cartons that differed only in the price or production method label. Figure 2 provides an example of the types of images that participants saw in the two experiments.

As Glimcher & Rustichini (2004) contended in a position paper on the discipline of neuroeconomics: "People are seen as deciding among options on the basis of the relative desirability of each option" and "[d]esirability is computed and is represented in the brain, and we now have the means to test, measure, and represent this activation." Varying the prices of foods and asking participants to make decisions among foods offered at different price points while their brain activity is measured is now a standard way of realizing the hopes that Glimcher and Rustichini articulated (see e.g. Kislov et al., 2023; Knutson et al., 2007). Because the use of new food production technologies involves cost, ethical, safety, and certainty tradeoffs, neuroeconomics researchers studying food purchase decisions have also presented consumers with alternative ways their food is produced to see how that changes decision-making (for a review see Lepping et al., 2015; Stasi et al., 2018).

fMRI data acquisition

Functional MRI data were analyzed using the BrainVoyager QX statistical package with random effects (Brain Innovation, Maastricht, Netherlands, 2004) and corrected for multiple comparisons. Following Martin et al. (2010), preprocessing steps included trilinear 3D motion correction, sinc-interpolated slice scan time correction, 3D spatial smoothing with 4-mm Gaussian filter, and high-pass filter temporal smoothing. Functional images were realigned to the anatomical images obtained within each session and standardized using BrainVoyager Talairach transformation, which conforms to the space defined by Talairach & Tournoux's (1988) stereotaxic atlas. Functional scans were discarded if participants moved more than 4 mm along any axis (x, y, or z). Two runs were discarded due to excess motion, and three participants were unable to complete the task, leaving a total of 92 runs. As in Moll et al. (2002) and Martin et al. (2010), activation maps were analyzed using the parametric statistical methods of Friston et al. (1995) (included in the BrainVoyager QX software). Blood oxygenation level-dependent (BOLD) activations during the choices were conducted using multiple-regression analysis (general linear model). Motion parameters were included as nuisance regressors. For the first-level analysis, regressors representing the decision phase (i.e., stimulus onset time to participant choice with an average duration of 2.7 seconds) for the experimental conditions of interest (e.g., price, production method, and combination) were modeled with a hemodynamic response filter and entered into the multiple-regression analysis using a random-effects model. In addition, the feedback phase (i.e., confirmation of feedback, 0.5 seconds) was included as a regressor of no interest. Regressors were modulated for the decision duration. However, there was no amplitude modulation or orthogonalization. Mean percent signal change values were extracted for each individual for each condition as described below to examine associations between product choices for each experiment.

No studies have yet examined the influence of political preferences on food choices during a neuroimaging experiment. As such, we had no specific *a priori* regions of interest related to politics during our food choice experiment. We therefore conducted a whole-brain analysis examining contrasts between self-reported Republicans and Democrats in blood oxygenation level-dependent (BOLD) activations from the price choices, production method choices, and combination choices. In this analysis, we subtracted the BOLD activation in the baseline condition averaged across voxels in the cluster of the whole-brain analysis from the choice (price, production method, or combination) condition. This removes the fixation effect so that the remaining BOLD activation would be consistent across participants. We further used a contrast method of two different tasks for extracting the BOLD activation and used Monte Carlo simulation to determine the threshold of 14 voxels ($k = 14$) at $p < 0.05$ and alpha of 0.01. To address concerns highlighted by Eklund et al. (2016), we took a number of steps such as using this family-wise error correction to create a more conservative determination of statistical significance. Along with our more conservative measures of the BOLD variables, our project has a relatively large sample for an fMRI study. To check for spurious BOLD extraction, we further test the fitness of our BOLD variables in a logistic regression model of political affiliation.

Results and Discussion

Summary statistics for behavioral choice data

The summary results of the food choices are in Table 1. For the milk and egg combination choices, *there is no significant difference* between Republicans and Democrats in the average number of choices for the various milk or egg conditions. Thus, food choice itself does not reveal political parties in these experiments. Sayre (2011) argues that it is not the food choice that reveals political differences but *how* one makes decisions about food. The finding of significantly different brain activation by political parties during the decision-making process may suggest that the participants are using different underlying thought processes when presented with the choices.

Table 1. Summary Statistics of the Number of Choices Made in the Milk and Egg Combination Experiments

Number of choices	M	SD	t	p-value
Cloned milk				
Democrats ($N = 18$)	6.2	6.3	−0.40	0.69
Republican ($N = 14$)	7.1	5.7		
Growth-hormone milk				
Democrats ($N = 18$)	5.2	6.5	−1.11	0.28
Republican ($N = 14$)	7.6	5.8		
Cage-free eggs				
Democrats ($N = 22$)	8.1	5.1	0.71	0.48
Republican ($N = 11$)	6.7	6.0		
Free-range eggs				
Democrats ($N = 22$)	8.2	5.0	0.61	0.55
Republican ($N = 11$)	7.0	5.8		

Whole-brain analysis

Table 2 shows the brain regions with associated Brodmann areas where there were significant differences between Republicans and Democrats in each experimental condition ($p < 0.05$). Three of the areas listed in Table 2 are of less interest for the present work because of the lack of research linking these areas to issues of self-reflection, rationalization, emotion, politics, food choices, or behavioral or economic valuation. These areas are the middle temporal gyrus, the parahippocampus, and the superior temporal lobe. All three of these were active during the milk experiment only. The parahippocampus cortex is known to be associated with memory, especially encoding and retrieval of visual scene stimuli such as landscapes (Aminoff et al., 2013). The middle temporal gyrus and the superior temporal lobe are known to be important for the comprehension and recognition of words (Booth et al., 2002). Harpaz et al. (2009) also suggest that the superior temporal lobe plays a role in processing the subordinate meanings of ambiguous words. In the milk experiment, the labels informed participants of the usage of cloning and hormones, which are arguably more ambiguous than the cage/cage-free type labels in the eggs experiment. Because of the lack of related research linking these regions to areas other than word or image recognition, we are inclined toward skepticism as to their usefulness as general indicators of political preferences. We instead focus on the areas that have been documented in other research studies to be relevant to political preferences, as discussed above: the ventromedial prefrontal cortex, insular cortex, premotor/supplementary motor area, precuneus, and superior frontal gyrus.

Figures 3 and 4 illustrate significantly different brain activation by political parties shown in red (greater activation) and blue (less activation). Figure 3a shows the significant activation observed in the left ventromedial prefrontal cortex (vmPFC) for the milk production method condition relative to the baseline condition. The vmPFC is a region involved in processing and evaluation (Ruff & Fehr, 2014), associated with self-reflection and self-referential processing (Kelley et al., 2002; Macrae et al., 2004), as well as an area related to the valuation of items, monetary or otherwise (Levy & Glimcher, 2012) and has been implicated in previous research on politics (Knutson et al., 2006; Mitchell et al., 2006; Zamboni et al., 2009).

The combination condition decision-making is the most similar to real-life decisions where attributes like labels and prices vary among food choices. As Table 2 shows the left insula (also in Figure 3b) shows significantly stronger activity in Republicans than Democrats in the milk combination condition relative

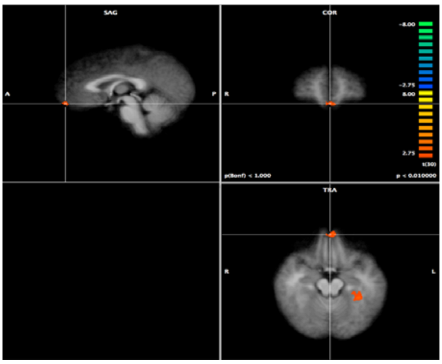
Table 2. Results from Whole-brain Analysis: BOLD Responses to Contrasts of Interest (p < 0.05)

	Max voxel coordinates				
Brain Region	**X**	**Y**	**Z**	**t**	**Cont. voxels**
Milk price choice vs. Baseline contrast: Republicans > Democrats					
(L) Middle temporal gyrus, BA 21	−68	−50	0	4.09	25
Milk production method choice vs. Baseline contrast: Republicans > Democrats					
(L) Ventromedial PFC, BA 10	−1	55	−12	3.78	14
(L) Parahippocampus, BA 36	−31	−29	−18	4.1	34
(L) Superior temporal lobe, BA 13	−55	−41	18	4.3	16
Milk combination choice vs. Baseline contrast: Republicans > Democrats					
(L) Insula, BA 13	−31	19	12	4.66	17
(L) Superior temporal lobe, BA 22	−64	−38	15	4.34	17
Egg production method choice vs. Baseline contrast: Republicans > Democrats					
(L) premotor/supplementary motor area, BA 6	−1	−17	60	3.79	16
Egg combination choice vs. Baseline contrast: Republicans < Democrats					
(R) Precuneus, BA 7	20	−62	36	−3.98	18
(R) Superior frontal gyrus, BA 10	20	55	21	−4.9	24

Notes: BA = Brodmann Area.

(a) Left vmPFC, BA 10

In milk production method relative to baseline condition.



(b) Left Insula, BA 13

In milk combination relative to baseline condition.

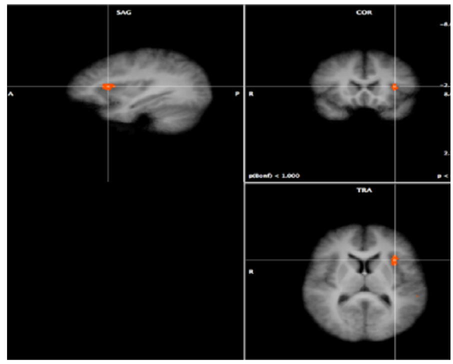
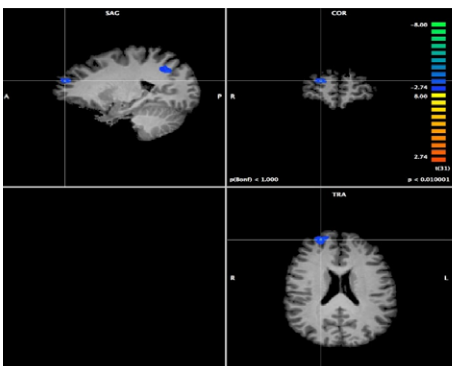


Figure 3. Whole-brain analysis in the milk experiment: Republican-Democrat contrasts.

(a) Right Superior frontal gyrus, BA 10

In egg combination relative to baseline condition.



(b) Left premotor/supplementary motor area, BA 6

In egg production method relative to baseline condition.

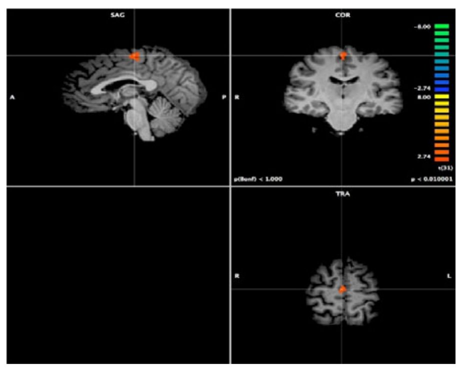


Figure 4. Whole-brain analysis in the egg experiment: Republican-Democrat contrasts.

to the baseline condition. The insula has been frequently implicated in our ability to feel our internal sensations, a phenomenon known as interoception (Haruki & Ogawa, 2021). Bartra et al. (2013) find that the left insula is associated with a person's subjective valuation of a good. Insula activity has been found to be an experience-value signal, also associated with pain (Ruff & Fehr, 2014) and disgust (Wicker et al., 2003). The neuropolitics literature shows that the insula is implicated in in-group bias (Kaplan et al., 2007; Westen et al., 2006) and political ideology (Kanai et al., 2011; Krosch et al., 2021; Schreiber et al., 2013).

In the egg combination condition, activity in the precuneus and superior frontal gyrus (Figure 4a) is significantly stronger in Democrats than Republicans. The precuneus is involved with episodic memory (Lundstrom et al., 2003) but also social cognition, including processing stories (Mar, 2011). The precuneus is frequently shown to be active while analyzing political information (Fowler & Schreiber, 2008; Gordon et al., 2019; Kaplan et al., 2016; Moore et al., 2021). The superior frontal gyrus has been posited as a gateway for directing attention and cognitive resources (Burgess et al., 2007). In the context of politics, it has been found to be active during the processing of political faces and attitudes in a version of the Implicit Association Test (Knutson et al., 2006).

Figure 4b illustrates significantly greater activation observed in the left premotor area (PMA)/ supplementary motor area (SMA) for Republicans than for Democrats for the egg production method condition relative to the baseline condition. Our findings may complement Amodio et al. (2007) who used a habitual-tendency Go/No-Go task, finding greater liberalism associated with more responsiveness to new, unexpected, conflicting information and stronger anterior cingulate activity.

Finally, neither Republicans nor Democrats have statistically significant differences in amygdala activity in our study, even though previous studies had shown differences between liberals and conservatives in this particular brain area (Ahn et al., 2014; Gozzi et al., 2010; Kanai et al., 2011; Knutson et al., 2006; Krosch et al., 2021; Pedersen et al., 2018; Rule et al., 2010; Schreiber et al., 2013). One reason may be that previous studies used stimuli that provoked stronger emotional reactions, such as images of politicians or threats of loss or pain. Our experiment portrayed food images for which only text labels and prices on the images differed. Food labels and prices may serve as cognitive information signals, especially in the milk experiment (Kolodinsky, 2008). The amygdala is not as involved in the higher-level cognitive functions like conceptual associations (Jost et al., 2014) but is involved with emotional responses and subsequent decisions. The milk and egg choices in our current experiment may not have elicited a very strong emotional response from participants.

How good is the model fitness for political views based on brain activity?

To evaluate model fitness, we followed the examples of Kanai et al. (2011), Schreiber et al. (2013), Ahn et al. (2014), and Yang et al. (2022) and explored how well the activity in the regions we identified could correctly classify a participant as Republican or Democrat. In Table 3, we show four logit regression models that use the results from whole-brain analysis to evaluate the model fitness of the brain activations for the participant's political view. In general, all four models do better than a random guess

Table 3. Logit Models' Fitness for Political View (Republican = 1)

	Model 1	**Model 2**	**Model 3**	**Model 4**
	Milk	**Milk**	**Egg**	**Egg**
	fMRI	**fMRI**	**fMRI**	**fMRI**
Intercept	−1.44**	−1.62**	0.89	0.27
BOLD activations in combination condition				
L Insula (milk experiment)	5.81**	5.41**		
Superior frontal gyrus (egg experiment)			10.94**	
Precuneus (egg experiment)			−15.99**	
BOLD activations in production method condition				
vmPFC (milk experiment)		2.45*		
Premotor/supplementary motor area (egg experiment)				−9.29**
N individuals	32	32	33	33
Overall % correctly classified	78%	78%	94%	76%
Republican % correctly classified	71%	71%	82%	55%
Democrat % correctly classified	83%	83%	100%	86%
$\chi 2$	8.86	13.61	24.02	10.07
Prob > $\chi 2$	0	0	0	0
Log L	−17.5	−15.12	−8.99	−15.97
AIC	39	36.25	23.99	35.94
Area under ROC	0.79	0.85	0.93	0.81

Notes: ***, **, and * indicate significance at the 1%. 5% and 10% levels, respectively.

(50%) and find that it is harder to correctly classify Republicans than it is to correctly classify Democrats. Our findings suggest that political orientation might be partially rooted in basic neurocognitive mechanisms that occur even when the choices are non-political.

Specifically, Model 1, which uses left insula activity in the milk combination condition relative to the baseline condition, achieves an overall correct classification accuracy of 78%. Compared with Model 1, Model 2 adds the vmPFC activity in the milk production method condition relative to the baseline condition. However, Model 2 does not improve the overall rate of correct classifications compared with Model 1, even though research commonly finds that the vmPFC activity is different in liberals and conservatives (Mitchell et al., 2006; Knutson et al., 2006; Zamboni et al., 2009). Model 3 includes as classifiers the areas examined in whole-brain analysis in the egg combination condition relative to the baseline condition and identifies 100% of Democrats correctly. Model 4, which uses a single brain activity variable from the egg production experiment, achieves a rate of correct classification of 76% for political affiliation. These results compare favorably with previous neuropolitics studies (Ahn et al., 2014; Kanai et al., 2011; Schreiber et al., 2013; Yang et al., 2022).

Conclusion

We found that when making non-hypothetical, economic decisions about food, Republicans show greater neural activity than Democrats in specific regions of the brain, and Democrats have greater neural activity than Republicans in other regions, yet the ultimate food decisions are not significantly different between the two groups. There is no specific conservative, liberal, Republican, or Democrat "grocery shopping" region of the brain, which means political decisions, economic decisions, and day-to-day decisions such as food choices must be made using the available decision "hardware." In this exploratory study, we expected that there might be differences in the food purchase decisions correlating with partisanship. When we found no differences in the decisions, it was then surprising that a whole-brain analysis revealed that certain regions showed significant differences between Republicans and Democrats when participants made food purchase decisions concerning milk and eggs. Along with using a very conservative extraction for our BOLD variables, we also examined the model fitness of these variables for political affiliation. Not only do our collected BOLD variables correctly classify political affiliation 76–94% of the time and perform better than a random baseline (50%), but they also outperform the baseline expectation from parental conservatism, as reported in Schreiber et al. (2013)(69.5%) and Yang et al. (2022)(71.5%).

In her famous research on crustacean neural systems, Eve Marder (Marder, 2011; Marder & Goaillard, 2006; Marder & Taylor, 2011) discovered that a wide range of distinct neural configurations can nonetheless lead to identical behavior. That particular behavior might be evolutionarily adaptive in the specific conditions, but evolution works on variation (Darwin, 1996 [1859]), and having identical neural systems generating the currently advantageous behavior would make a population evolutionarily vulnerable if conditions change. While Marder's initial research was at the level of basic neuroscience under laboratory conditions, her more recent work has seen the consequences of actual, rather than merely theoretical, changes in environmental conditions (Marder & Rue, 2021; Schapiro & Marder, 2024).

The wild-caught crabs brought into her lab now do not appear any different from the previous generations that she had studied in standard laboratory control conditions, but when exposed to temperature extremes in the lab, tremendous differences have recently arisen. Because most neuroscience research focused on carefully inbred model organisms like mice, flies, and worms, the assumption that all individual organisms use equivalent neural systems to generate equivalent behaviors is essentially baked in as a consequence of the experimental designs (Marder & Rue, 2021). Marder's reliance on wild-caught animals introduced a natural diversity that enabled her to make important insights into variations in neural systems that would not have been easily seen in typical white lab mice. But it has also turned a basic bench neuroscientist into an inadvertent climate researcher.

In the current project, we observed Republicans and Democrats generating indistinguishable food purchase behavior using *distinct* sets of neural mechanisms. This is much like the identical behavior of crabs that came from distinct neural systems in Marder's early work (Marder & Goaillard, 2006). The field of political science has historically focused on behaviors like voting, protesting, or responding to survey questions, particularly because it was so difficult to measure processes or subjective states (Converse, 1964), but the neural underpinnings of such behaviors have yet to be fully elucidated.

As Marder's research shows, however, focusing entirely on behaviors constrains our ability to understand the function of the 'multiple solutions' (Marder, 2011) that might still generate the same outcomes. If, ultimately, we want to move towards *explaining* differences among partisans rather than merely describing them, it is critical that we investigate the instances where the underlying processes differ, not merely the behaviors. A classic '66 Mustang and a modern Tesla may both drive down the same road at the same speed and make the same turn, but looking under the hood reveals important distinctions. The accumulating evidence that neural differences that are strongly correlated to partisanship or political ideology nonetheless generate identical nonpolitical behavior (Schreiber, 2018) highlights the limits of merely studying behavior and the importance of understanding *why* these neurological processes correlate with political differences.

Much of early neuroscience and early political science assumed roughly equivalent mechanisms driving equivalent behaviors. From John Locke (1690) on through the twentieth century's political behavior research, the emphasis was on the environment and experience of writing on similarly situated blank slates (Pinker, 2002). Likewise, in psychology and neuroscience, the emphasis was on the external stimulus generating the response in carefully controlled experiments with roughly identical lab animals (Skinner, 1938). The tools of basic neuroscience are now revealing the diversity of neural systems in both crabs and humans. Both humans and crabs may exhibit fight or flight responses when threatened, but that fact obscures the diverse neural systems generating those similar behaviors.

In a time when affective polarization is raising the political temperature, some previous brain imaging studies demonstrated identical behaviors coming from distinct neural activity corresponding with party and ideology amid emotionally charged nonpolitical tasks (risk, disgust, pain, etc.) Other studies showed brain synchronization regardless of political affiliation when participants watched neutral documentary videos, but a tendency for brains to polarize along party lines when people viewed contentious political content such as campaign ads, speeches, and debates (Katabi et al., 2023; van Baar et al., 2021). We use the same brain for all of the activities and choices in which we engage.

Like Marder's early basic neuroscience research under mundane conditions, this paper has shown that mundane decisions like purchasing eggs or milk can lack emotional potency and political content, yield unremarkable behaviors, and nonetheless enable us to correctly classify someone by party affiliation. If the political climate continues to warm, basic research into the neural mechanisms that differ and yet appear to lie dormant in ordinary circumstances may be critical for understanding increasing affective polarization. Future research will need to examine how brains function during *daily* decision-making if we are to untangle the complexities of *political* decision-making.

Data availability statement. The data that support the findings of this study are available on request from the corresponding author, DS. The data are not publicly available due to legal and ethical restrictions (e.g. their containing information that could compromise the privacy of research participants.)

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Competing interest. The authors have no competing interests.

Ethical standard. The present study was approved by the Social Sciences Institutional Review Board of the University of Missouri–Kansas City (UMKC), as well as the Human Subjects Committee of the University of Kansas Medical Center (KUMC). All participants provided their written, informed consent to participate, the procedure for which was also approved by the aforementioned institutions.

References

Aaroe, L., & Petersen, M. B. (2013). Hunger Games: Fluctuations in Blood Glucose Levels Influence Support for Social Welfare. *Psychological Science*, **24**(12), 2550–2556. https://doi.org/10.1177/0956797613495244

Adorno, T. W. (1950). *The Authoritarian personality* (1st ed.). Harper.

Ahn, W. Y., Kishida, K. T., Gu, X., Lohrenz, T., Harvey, A., Alford, J. R., … Montague, P. R. (2014). Nonpolitical Images Evoke Neural Predictors of Political Ideology. *Current Biology*, **24**(22), 2693–2699. https://doi.org/10.1016/j.cub.2014.09.050

Alford, J. R., Funk, C. L., & Hibbing, J. R. (2005). Are Political Orientations Genetically Transmitted? *American Political Science Review*, **99**(2), 153–167. https://doi.org/10.1017/S0003055405051579

Aminoff, E. M., Kveraga, K., & Bar, M. (2013). The role of the parahippocampal cortex in cognition. [Review]. *Trends in Cognitive Science*, **17**(8), 379–390. https://doi.org/10.1016/j.tics.2013.06.009

Amodio, D. M., Jost, J. T., Master, S. L., & Yee, C. M. (2007). Neurocognitive correlates of liberalism and conservatism. *Nat Neurosci*, **10**(10), 1246–1247. https://doi.org/10.1038/nn1979

Bakker, B. N., & Lelkes, Y. (2018). Selling Ourselves Short? How Abbreviated Measures of Personality Change the Way We Think about Personality and Politics. *Journal of Politics*, **80**(4), 1311–1325. https://doi.org/10.1086/698928

Bakker, B. N., Schumacher, G., Gothreau, C., & Arceneaux, K. (2020). Conservatives and liberals have similar physiological responses to threats. *Nature Human Behaviour*, **4**(6), 613–621. https://doi.org/10.1038/s41562-020-0823-z

Barber, M., & McCarty, N. (2016). Causes and Consequences of Polarization. In J. Mansbridge & C. J. Martin (Eds.), *Political Negotiation: A Handbook* (pp. 37–90). Brookings Institution Press.

Bartra, O., McGuire, J. T., & Kable, J. W. (2013). The valuation system: a coordinate-based meta-analysis of BOLD fMRI experiments examining neural correlates of subjective value. [Meta-Analysis]. *Neuroimage*, **76**, 412–427. https://doi.org/10.1016/j.neuroimage.2013.02.063

Booth, J. R., Burman, D. D., Meyer, J. R., Gitelman, D. R., Parrish, T. B., & Mesulam, M. M. (2002). Modality independence of word comprehension. *Human Brain Mapping*, **16**(4), 251–261. https://doi.org/10.1002/hbm.10054

Boyland, E., Maden, M., Coates, A. E., Masterson, T. D., Alblas, M. C., Bruce, A. S., & Roberts, C. A. (2024). Food and non-alcoholic beverage marketing in children and adults: A systematic review and activation likelihood estimation meta-analysis of functional magnetic resonance imaging studies. [Meta-Analysis]. *Obesity reviews : an official journal of the International Association for the Study of Obesity*, **25**(1), e13643. https://doi.org/10.1111/obr.13643

Burgess, P. W., Dumontheil, I., & Gilbert, S. J. (2007). The gateway hypothesis of rostral prefrontal cortex (area 10) function. *Trends in Cognitive Sciences*, **11**(7), 290–298. https://doi.org/10.1016/j.tics.2007.05.004

Carmines, E. G., & D'Amico, N. J. (2015). The New Look in Political Ideology Research. *Annual Review of Political Science*, **18**(1), 205–216. https://doi.org/10.1146/annurev-polisci-060314-115422

Chuck, C., Fernandes, S. A., & Hyers, L. L. (2016). Awakening to the politics of food: Politicized diet as social identity. *Appetite*, **107**(C), 425–436. https://doi.org/10.1016/j.appet.2016.08.106

Clifford, S., & Wendell, D. G. (2015). How Disgust Influences Health Purity Attitudes. *Political Behavior*, **38**(1), 155–178. https://doi.org/10.1007/s11109-015-9310-z

Converse, P. (1964). The Nature of Belief Systems in Mass Publics. In D. Apter (Ed.), *Ideology and Discontent* (pp. 206–261). Free Press.

Danziger, S., Levav, J., & Avnaim-Pesso, L. (2011). Extraneous factors in judicial decisions. *Proc Natl Acad Sci USA*, **108**(17), 6889–6892. https://doi.org/10.1073/pnas.1018033108

Darwin, C. (1996 [1859]). *The origin of species*. Oxford University Press.

Dennison, J. B., Sazhin, D., & Smith, D. V. (2022). Decision neuroscience and neuroeconomics: Recent progress and ongoing challenges. [Review]. *Wiley Interdisciplinary Reviews: Cognitive Science*, **13**(3), e1589. https://doi.org/10.1002/wcs.1589

Diamond, J. M. (2005). *Collapse : how societies choose to fail or succeed*. Viking.

Dreezens, E., Martijn, C., Tenbült, P., Kok, G., & de Vries, N. K. (2005). Food and values: an examination of values underlying attitudes toward genetically modified- and organically grown food products. *Appetite*, **44**(1), 115–122. https://doi.org/10.1016/j.appet.2004.07.003

Eickhoff, S. B., Bzdok, D., Laird, A. R., Kurth, F., & Fox, P. T. (2012). Activation likelihood estimation meta-analysis revisited. *Neuroimage*, **59**(3), 2349–2361. https://doi.org/10.1016/j.neuroimage.2011.09.017

Eklund, A., Nichols, T. E., & Knutsson, H. (2016). Cluster failure: Why fMRI inferences for spatial extent have inflated false-positive rates. *Proceedings of the National Academy of Sciences of the United States of America*, **113**(28), 7900–7905. https://doi.org/10.1073/pnas.1602413113

Feldman, S., & Stenner, K. (1997). Perceived Threat and Authoritarianism. *Political Psychology*, **18**(4), 741–770. https://doi.org/10.1111/0162-895X.00077

Fiorina, M. P., & Abrams, S. J. (2009). *Disconnect : the breakdown of representation in American politics*. University of Oklahoma Press.

Fowler, J., & Schreiber, D. (2008). Biology, politics, and the emerging science of human nature. *Science*, **322**(5903), 912–914. https://doi.org/10.1126/science.1158188

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. https://doi.org/10.1017/pls.2019.18

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* (2), 152–171. https://doi.org/10.1017/pls.2021.20

Friston, K. J., Holmes, A. P., Worsley, K. J., Poline, J. P., Frith, C. D., & Frackowiak, R. S. J. (1995). Statistical Parametric Maps in Functional Imaging: A General Linear Approach. *Human Brain Mapping*, **2**, 189–210. https://doi.org/10.1002/hbm.460020402

Glimcher, P. W., & Rustichini, A. (2004). Neuroeconomics: The Consilience of Brain and Decision. *Science*, **306**(5695), 447–452. https://doi.org/10.1126/science.1102566

Gordon, A., Quadflieg, S., Brooks, J. C. W., Ecker, U. K. H., & Lewandowsky, S. (2019). Keeping track of 'alternative facts' The neural correlates of processing misinformation corrections. *Neuroimage*, **193**, 46–56. https://doi.org/10.1016/j.neuroimage.2019.03.014

Gozzi, M., Zamboni, G., Krueger, F., & Grafman, J. (2010). Interest in politics modulates neural activity in the amygdala and ventral striatum. *Human Brain Mapping*, **31**(11), 1763–1771. https://doi.org/10.1002/hbm.20976

Haidt, J., & Graham, J. (2007). When Morality Opposes Justice: Conservatives Have Moral Intuitions that Liberals may not Recognize. *Social Justice Research*, **20**(1), 98–116. https://doi.org/10.1007/s11211-007-0034-z

Harpaz, Y., Levkovitz, Y., & Lavidor, M. (2009). Lexical ambiguity resolution in Wernicke's area and its right homologue. *Cortex*, **45**(9), 1097–1103. https://doi.org/10.1016/j.cortex.2009.01.002

Haruki, Y., & Ogawa, K. (2021). Role of anatomical insular subdivisions in interoception: Interoceptive attention and accuracy have dissociable substrates. *The European journal of neuroscience*, **53**(8), 2669–2680. https://doi.org/10.1111/ejn.15157

Hatemi, P. K., Crabtree, C., & Smith, K. B. (2019). Ideology Justifies Morality: Political Beliefs Predict Moral Foundations. *American Journal of Political Science*, **63**(4), 788–806. https://doi.org/10.1111/ajps.12448

Hatemi, P. K., & McDermott, R. (2012). The genetics of politics: discovery, challenges, and progress. *Trends in Genetics*, **26**(10), 525–533. https://doi.org/10.1016/j.tig.2012.07.004

Hatemi, P. K., & McDermott, R. (2016). Give Me Attitudes. *Annual Review of Political Science*, **19**(1), 331–350. https://doi.org/10.1146/annurev-polisci-103113-034929

Hatemi, P. K., & Verhulst, B. (2015). Political attitudes develop independently of personality traits. *PLoS One*, **10**(3), e0118106. https://doi.org/10.1371/journal.pone.0118106

Henrich, J. (2009). The evolution of costly displays, cooperation and religion: credibility enhancing displays and their implications for cultural evolution. *Evolution and Human Behavior*, **30**(4), 244–260. https://doi.org/10.1016/j.evolhumbehav.2009.03.005

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

Iyengar, S., Lelkes, Y., Levendusky, M., Malhotra, N., & Westwood, S. J. (2018). The Origins and Consequences of Affective Polarization in the United States. *Annual Review of Political Science*, **22**(1), 129–146. https://doi.org/10.1146/annurev-polisci-051117-073034

Jost, J. T., & Amodio, D. M. (2012). Political ideology as motivated social cognition: Behavioral and neuroscientific evidence. *Motivation and Emotion*, **36**(1), 55–64. https://doi.org/10.1007/s11031-011-9260-7

Jost, J. T., Glaser, J., Kruglanski, A. W., & Sulloway, F. J. (2003). Political conservatism as motivated social cognition. *Psychological Bulletin*, **129**(3), 339–375. https://doi.org/10.1037/0033-2909.129.3.339

Jost, J. T., Nam, H. H., Amodio, D. M., & Van Bavel, J. J. (2014). Political Neuroscience: The Beginning of a Beautiful Friendship. *Political Psychology*, **35**, 3–42. https://doi.org/10.1111/pops.12162

Kanai, R., Feilden, T., Firth, C., & Rees, G. (2011). Political Orientations Are Correlated with Brain Structure in Young Adults. *Current Biology*, **21**(8), 677–680. https://doi.org/10.1016/j.cub.2011.03.017

Kaplan, J. T., Freedman, J., & Iacoboni, M. (2007). Us versus them: Political attitudes and party affiliation influence neural response to faces of presidential candidates. *Neuropsychologia*, **45**(1), 55–64. https://doi.org/10.1016/j.neuropsychologia.2006.04.024

Kaplan, J. T., Gimbel, S. I., & Harris, S. (2016). Neural correlates of maintaining one's political beliefs in the face of counterevidence. *Scientific Reports*, **6**(1), 39589. https://doi.org/10.1038/srep39589

Katabi, N., Simon, H., Yakim, S., Ravreby, I., Ohad, T., & Yeshurun, Y. (2023). Deeper Than You Think: Partisanship-Dependent Brain Responses in Early Sensory and Motor Brain Regions. *The Journal of neuroscience : the official journal of the Society for Neuroscience*, **43**(6), 1027–1037. https://doi.org/10.1523/JNEUROSCI.0895-22.2022

Kato, J., Ide, H., Kabashima, I., Kadota, H., Takano, K., & Kansaku, K. (2009). Neural correlates of attitude change following positive and negative advertisements. *Frontiers in Behavioral Neuroscience*, **3**, 505. https://doi.org/10.3389/neuro.08.006.2009

Keefe, J. (2020). *Quiz: Can You Tell a 'Trump' Fridge From a 'Biden' Fridge? TheUpshot*. https://www.nytimes.com/interactive/2020/10/27/upshot/biden-trump-poll-quiz.html

Kelley, W. M., Macrae, C. N., Wyland, C. L., Caglar, S., Inati, S., & Heatherton, T. F. (2002). Finding the self? An event-related fMRI study. *Journal of Cognitive Neuroscience*, **14**(5), 785–794. https://doi.org/10.1162/08989290260138672

Kislov, A., Shestakova, A., Ushakov, V., Martinez-Saito, M., Beliaeva, V., Savelo, O., … Klucharev, V. (2023). The prediction of market-level food choices by the neural valuation signal. *PLoS One*, **18**(6), e0286648. https://doi.org/10.1371/journal.pone.0286648

Knutson, B., Rick, S., Wimmer, G. E., Prelec, D., & Loewenstein, G. (2007). Neural predictors of purchases. *Neuron*, **53**(1), 147–156. https://doi.org/10.1016/j.neuron.2006.11.010

Knutson, K. M., Wood, J. N., Spampinato, M. V., & Grafman, J. (2006). Politics on the brain: an FMRI investigation. *Social neuroscience*, **1**(1), 25–40. https://doi.org/10.1080/17470910600670603

Kolodinsky, J. (2008). Affect or information? Labeling policy and consumer valuation of rBST free and organic characteristics of milk. *Food Policy*, **33**, 616–623. https://doi.org/10.1016/j.foodpol.2008.07.002

Krastev, S., McGuire, J. T., McNeney, D., Kable, J. W., Stolle, D., Gidengil, E., & Fellows, L. K. (2016). Do Political and Economic Choices Rely on Common Neural Substrates? A Systematic Review of the Emerging Neuropolitics Literature. *Front Psychol*, **7**, 264. https://doi.org/10.3389/fpsyg.2016.00264

Krosch, A. R., Jost, J. T., & Van Bavel, J. J. (2021). The neural basis of ideological differences in race categorization. *Philosophical Transactions of the Royal Society B: Biological Sciences*, **376**(1822), 20200139. https://doi.org/10.1098/rstb.2020.0139

Lepping, R. J., Papa, V. B., & Martin, L. E. (2015). Cognitive Neuroscience Perspectives on Food Decision-Making: A Brief Introduction. *Journal of Agricultural & Food Industrial Organization*, **13**(1), 5–14. https://doi.org/10.1515/jafio-2015-0026

Levy, D. J., & Glimcher, P. W. (2012). The root of all value: a neural common currency for choice. *Current Opinion in Neurobiology*, **22**(6), 1027–1038. https://doi.org/10.1016/j.conb.2012.06.001

Locke, J. (1690). *An essay concerning human understanding : in four books* (George Fabyan Collection (Library of Congress) ed.). Thomas Bassett

Lundstrom, B. N., Petersson, K. M., Andersson, J., Johansson, M., Fransson, P., & Ingvar, M. (2003). Isolating the retrieval of imagined pictures during episodic memory: activation of the left precuneus and left prefrontal cortex. [Clinical Trial]. *Neuroimage*, **20**(4), 1934–1943. https://doi.org/10.1016/j.neuroimage.2003.07.017

Lusk, J. L. (2012). The political ideology of food. *Food Policy*, **37**(5), 530–542. https://doi.org/10.1016/j.foodpol.2012.05.002

Macrae, C. N., Moran, J. M., Heatherton, T. F., Banfield, J. F., & Kelley, W. M. (2004). Medial Prefrontal Activity Predicts Memory for Self. *Cerebral Cortex*, **14**(6), 647–654. https://doi.org/10.1093/cercor/bhh025

Mar, R. A. (2011). The neural bases of social cognition and story comprehension. [Review]. *Annual review of psychology*, **62**, 103–134. https://doi.org/10.1146/annurev-psych-120709-145406

Marder, E. (2011). Variability, compensation, and modulation in neurons and circuits. [Review]. *Proceedings of the National Academy of Sciences of the United States of America*, **108** Suppl 3, 15542–15548. https://doi.org/10.1073/pnas.1010674108

Marder, E., & Goaillard, J.-M. (2006). Variability, compensation and homeostasis in neuron and network function. [Review]. *Nature Reviews Neuroscience*, **7**(7), 563–574. https://doi.org/10.1038/nrn1949

Marder, E., & Rue, M. C. P. (2021). From the Neuroscience of Individual Variability to Climate Change. *The Journal of neuroscience : the official journal of the Society for Neuroscience*, **41**(50), 10213–10221. https://doi.org/10.1523/JNEUROSCI.1261-21.2021

Marder, E., & Taylor, A. L. (2011). Multiple models to capture the variability in biological neurons and networks. *Nature Neuroscience*, **14**(2), 133–138. https://doi.org/10.1038/nn.2735

Martin, L. E., Holsen, L. M., Chambers, R. J., Bruce, A. S., Brooks, W. M., Zarcone, J. R., … Savage, C. R. (2010). Neural mechanisms associated with food motivation in obese and healthy weight adults. *Obesity (Silver Spring, Md.)*, **18**(2), 254–260. https://doi.org/10.1038/oby.2009.220

Mason, L. (2018). *Uncivil Agreement: How Politics Became Our Identity*. University of Chicago Press.

McClosky, H. (1958). Conservatism and Personality. *American Political Science Review*, **52**(1), 27. https://doi.org/10.2307/1953011

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. https://doi.org/10.1111/ajps.12133

Mitchell, J. P., Macrae, C. N., & Banaji, M. R. (2006). Dissociable medial prefrontal contributions to judgments of similar and dissimilar others. *Neuron*, **50**(4), 655–663. https://doi.org/10.1016/j.neuron.2006.03.040

Moll, J., de Oliveira-Souza, R., Eslinger, P. J., Bramati, I. E., Mourão-Miranda, J., Andreiuolo, P. A., & Pessoa, L. (2002). The neural correlates of moral sensitivity: a functional magnetic resonance imaging investigation of basic and moral emotions [Clinical Trial]. *The Journal of neuroscience : the official journal of the Society for Neuroscience*, **22**(7), 2730–2736. https://doi.org/10.1523/JNEUROSCI.22-07-02730.2002

Moore, A., Hong, S., & Cram, L. (2021). Trust in information, political identity and the brain: an interdisciplinary fMRI study. *Philosophical Transactions of the Royal Society B: Biological Sciences*, **376**(1822), 20200140. https://doi.org/10.1098/rstb.2020.0140

Mosier, S. L., & Rimal, A. P. (2020). Where's the meat? An evaluation of diet and partisanship identification. *British Food Journal*, **122**(3), 896–909. https://doi.org/10.1108/BFJ-03-2019-0193

Oosterhoff, B., Shook, N. J., & Ford, C. (2018). Is that disgust I see? Political ideology and biased visual attention. *Behav Brain Res*, **336**, 227–235. https://doi.org/10.1016/j.bbr.2017.09.005

Osmundsen, M., Hendry, D., Laustsen, L., Smith, K., & Petersen, M. B. (2022). The Psychophysiology of Political Ideology: Replications, Reanalysis and Recommendations. *Journal of Politics*, **81**(1), 50–66. https://doi.org/10.1086/714780

Oxley, D. R., Smith, K. B., Alford, J. R., Hibbing, M. V., Miller, J. L., Scalora, M., … Hibbing, J. R. (2008). Political attitudes vary with physiological traits. *Science*, **321**(5896), 1667–1670. https://doi.org/10.1126/science.1157627

Pedersen, W. S., Muftuler, L. T., & Larson, C. L. (2018). Conservatism and the neural circuitry of threat: economic conservatism predicts greater amygdala–BNST connectivity during periods of threat vs safety. *Social Cognitive and Affective Neuroscience*, **13**(1), 43–51. https://doi.org/10.1093/scan/nsx133

Petalas, D. P., Schumacher, G., & Scholte, S. H. (2024). Is political ideology correlated with brain structure? A preregistered replication. *ISCIENCE*, 110532. https://doi.org/10.1016/j.isci.2024.110532

Pinker, S. (2002). *The blank slate : the modern denial of human nature*. Viking.

Pollack, A. (2006). *Which Cows Do You Trust? New York Times*. https://www.nytimes.com/2006/10/07/business/07milk.html

Popkin, S. L. (1991). *The reasoning voter : communication and persuasion in presidential campaigns*. University of Chicago Press.

Rokeach, M. (1968). The Role of Values in Public Opinion Research. *The Public Opinion Quarterly*, **32**(4), 547–559. https://doi.org/10.1086/267645

Ruff, C. C., & Fehr, E. (2014). The neurobiology of rewards and values in social decision making [Review]. *Nature Reviews Neuroscience*, **15**(8), 549–562. https://doi.org/10.1038/nrn3776

Rule, N. O., Freeman, J. B., Moran, J. M., Gabrieli, J. D. E., Adams, R. B., & Ambady, N. (2010). Voting behavior is reflected in amygdala response across cultures. *Social Cognitive and Affective Neuroscience*, **5**(2–3), 349–355. https://doi.org/10.1093/scan/nsp046

Sagiv, L., Roccas, S., Cieciuch, J., & Schwartz, S. H. (2017). Personal values in human life. *Nat. hum. behav.*, **1**(9), 630–639. https://doi.org/10.1038/s41562-017-0185-3

Sayre, L. (2011). The Politics of Organic Farming: Populists, Evangelicals, and the Agriculture of the Middle. *Gastronomica: The Journal of Food and Culture*, **11**(2), 38–47. https://doi.org/10.1525/gfc.2011.11.2.38

Schapiro, K., & Marder, E. (2024). Resilience of circuits to environmental challenge. *Current Opinion in Neurobiology*, **87**, 102885. https://doi.org/10.1016/j.conb.2024.102885

Schreiber, D. (2018). Neuropolitics: Twenty years later. *Politics and the Life Sciences*, **36**(2), 114–131. https://doi.org/10.1017/pls.2017.25

Schreiber, D., Fonzo, G., Simmons, A., Dawes, C., Flagan, T., & Paulus, M. P. (2020). Neural nonpartisans. *Journal of Elections, Public Opinion & Parties*. https://doi.org/10.1080/17457289.2020.1801695

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. https://doi.org/10.1371/journal.pone.0052970

Schwartz, S. (1992). Universals in the content and structure of values. In M. P. Zanna (Ed.), *Advances in Experimental Social Psychology* (Vol. **25**, pp. 1–65). Academic Press.

Schwartz, S. H., Caprara, G. V., Vecchione, M., Bain, P., Bianchi, G., Caprara, M. G., … Zaleski, Z. (2014). Basic Personal Values Underlie and Give Coherence to Political Values: A Cross National Study in 15 Countries. *Political Behavior*, **36**(4), 899–930. https://doi.org/10.1007/s11109-013-9255-z

Shook, N. J., Oosterhoff, B., Terrizzi, J., John A, & Brady, K. M. (2017). "Dirty politics": The role of disgust sensitivity in voting. *Translational Issues in Psychological Science*, **3**(3), 284–297. https://doi.org/10.1037/tps0000111

Sidanius, J., & Pratto, F. (1999). *Social dominance : an intergroup theory of social hierarchy and oppression*. Cambridge University Press.

Skinner, B. F. (1938). *The behavior of organisms; an experimental analysis.* D. Appleton-Century Company, incorporated.

Smith, K., Alford, J. R., Hatemi, P. K., Eaves, L. J., Funk, C., & Hibbing, J. R. (2012). Biology, Ideology, and Epistemology: How Do We Know Political Attitudes Are Inherited and Why Should We Care? *American Journal of Political Science*, **56**(1), 17–33. https://doi.org/10.1111/j.1540-5907.2011.00560.x

Stasi, A., Songa, G., Mauri, M., Ciceri, A., Diotallevi, F., Nardone, G., & Russo, V. (2018). Neuromarketing empirical approaches and food choice: A systematic review. [Review]. *Food research international (Ottawa, Ont.)*, **108**, 650–664. https://doi.org/10.1016/j.foodres.2017.11.049

Talairach, J., & Tournoux, P. (1988). *Co-planar stereotaxic atlas of the human brain : 3-dimensional proportional system : an approach to cerebral imaging.* Thieme Medical Publishers.

Tusche, A., Kahnt, T., Wisniewski, D., & Haynes, J.-D. (2013). Automatic processing of political preferences in the human brain. *Neuroimage*, **72**, 174–182. https://doi.org/10.1016/j.neuroimage.2013.01.020

van Baar, J. M., Halpern, D. J., & FeldmanHall, O. (2021). Intolerance of uncertainty modulates brain-to-brain synchrony during politically polarized perception. *Proceedings of the National Academy of Sciences of the United States of America*, **118**(20). https://doi.org/10.1073/pnas.2022491118

Venkatraman, V., Dimoka, A., & Pavlou, P. A. (2015). Predicting Advertising Success Beyond Traditional Measures: New Insights from Neurophysiological Methods and Market Response Modeling. *Journal of Marketing Research*, **52**(4), 436–452. https://doi.org/10.1509/jmr.13.0593

Wasserman, D. (2014). *Senate Control Could Come Down To Whole Foods vs. Cracker Barrel*. https://fivethirtyeight.com/features/senate-control-could-come-down-to-whole-foods-vs-cracker-barrel/

Webster, S. W., & Abramowitz, A. I. (2017). The Ideological Foundations of Affective Polarization in the U.S. Electorate. *American Politics Research*, **45**(4), 621–647. https://doi.org/10.1177/1532673X17703132

Westen, D., Blagov, P., Harenski, K., Kilts, C., & Hamann, S. (2006). Neural Bases of Motivated Reasoning: An fMRI Study of Emotional Constraints on Partisan Political Judgment in the 2004 U.S. Presidential Election. *Journal of Cognitive Neuroscience*, **18**(11), 1947–1958. https://doi.org/10.1162/jocn.2006.18.11.1947

Wicker, B., Keysers, C., Plailly, J., Royet, J. P., Gallese, V., & Rizzolatti, G. (2003). Both of us disgusted in My insula: the common neural basis of seeing and feeling disgust. *Neuron*, **40**(3), 655–664. https://doi.org/10.1016/s0896-6273(03)00679-2

Yang, S. E., Wilson, J. D., Lu, Z.-L., & Cranmer, S. (2022). Functional connectivity signatures of political ideology. *PNAS Nexus*, **1**(3), pgac066. https://doi.org/10.1093/pnasnexus/pgac066

Zaller, J. R. (1992). *The Nature and Origin of Mass Opinion*. Cambridge University Press.

Zamboni, G., Gozzi, M., Krueger, F., Duhamel, J.-R., Sirigu, A., & Grafman, J. (2009). Individualism, conservatism, and radicalism as criteria for processing political beliefs: a parametric fMRI study. *Social neuroscience*, **4**(5), 367–383. https://doi.org/10.1080/17470910902860308

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