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Political Neuroscience

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Political Neuroscience

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1. Political Neuroscience

The field of political science has traditionally had close ties to disciplines like economics, history, and sociology. While political science has always been somewhat interdisciplinary in nature, in recent years this interdisciplinary approach has expanded to include biology, psychology, and neuroscience. This interest in the human sciences has led to the development of new subfields within political science, including biopolitics, political psychology, and political neuroscience (also called neuropolitics). What these new subfields have in common is an interest in individual human behavior and decision-making as an approach to understanding political behavior. While political science has traditionally focused on understanding politics in the aggregate, new methods and techniques are improving our ability to understand political behavior at the individual level and consider how individual differences in information processing may give rise to political behavior that is observed at the mass level.

While political science, psychology, and neuroscience have fairly distinct intellectual histories, it makes sense to combine them. While some political scientists think about politics as a special type of human behavior, and some psychologists dismiss the study of politics as too applied, a case can be made for the idea that politics and psychology share significant overlap. From the perspective of human evolution and the development of social behavior, it seems clear that social and political behavior have been historically intertwined.^{1,2} Just as the brain evolved to deal with larger and larger social groups, it became necessary to consider how those groups should be governed. From this perspective, it seems obvious to suggest that political behavior can be understood through the lens of human psychology, biology, and neuroscience.

As with any interdisciplinary or multidisciplinary approach, there are a number of challenges for researchers working in this area. While it has become increasingly clear that recent advances in social and cognitive neuroscience will help improve our understanding of political behavior, there are significant challenges that arise when trying to engage in this type of multilevel analysis—it is not always easy to translate what happens at the neural level into much more abstract notions about how society functions.

In this chapter, I will outline the contributions that political neuroscience has made thus far and discuss areas where political neuroscience may have the most to contribute moving forward. The chapter will focus on four important questions within political psychology and discuss the role for neuroimaging work within these areas: (1) political attitudes and evaluation, (2) social cognition and politics, (3) emotion and politics, and (4) individual differences in political behavior. Given that political neuroscience is in its infancy, the discussion of work in this area will be supplemented with relevant work from social and cognitive neuroscience, as well as social and political psychology more broadly. I think political scientists and neuroscientists can benefit from firmly grounding their ideas in social psychological theory, and social psychologists can benefit from an increasing understanding of brain function, as well as increased consideration of the role of context. After reviewing the current state of the literature in political neuroscience, I will offer some suggestions for future work.

2. A Brief Overview of Neuroimaging Methods

Many of the chapters in this volume will no doubt discuss neuroimaging methodology in extensive detail, but it is worth providing a brief overview here of neuroimaging methods used by political neuroscientists, especially for those readers who may be new to the field. The growth of methods like fMRI has been exponential since 1990.³ The use of these methods to study questions in political neuroscience has followed suit, although I think it is fair to say that political neuroscience is not quite as well established at this point. It is still possible to create a (relatively short) list of all the political neuroscience studies that have been conducted with structural Magnetic Resonance Imaging (MRI) or functional neuroimaging (fMRI) or electroencephalography (EEG).

There have been multiple attempts to describe how political science and cognitive neuroscience might be able to learn from one another, perhaps dating back to a special issue of the journal *Political Psychology* published in 2003.⁴⁻⁶ Although acceptance of this idea has grown, some political scientists remain skeptical of the idea that adopting neuro-

imaging methods will strengthen the field. More recently, people have called for balance on this issue—it is important to not overstate the claims we can make based on methods like functional Magnetic Resonance Imaging (fMRI) but also important not to be overly dismissive and to be aware that this field is still in its infancy.⁷ These methods are unlikely to replace traditional methods in political science research, but they may be used by some political scientists (through additional training or through collaboration) to help supplement our understanding of important questions in the field.

Given that this volume is focused on the role of neuroimaging, my goal here is to discuss neuroimaging research as it relates to political science. With that in mind, I will focus primarily on research using structural and functional imaging. It is important to note that a lot of research in the domain of biopolitics has also begun to investigate these issues using methods from psychophysiology, but that is beyond the scope of this chapter. For readers who are less familiar with these methods, I will offer a brief overview below. It is important to be aware that different methods have different strengths and weaknesses, and may be amenable to different types of research questions.

2.1 Structural Magnetic Resonance Imaging

Magnetic Resonance Imaging (MRI) is a technology that allows researchers to take three-dimensional images of the brain. This technology allows for much more detailed resolution than older imaging technologies like X-ray, CT scan, or positron emission technology (PET) scan. For example, a 3 Tesla MRI can produce a three-dimensional image of the brain at a resolution of $1 \times 1 \times 1$ mm. Structural MRI can be used to examine and compare the size and composition of different subregions within the brain across individuals. In relation to politics, this technique is most useful for individual difference analyses where different brain regions or structures are compared across individuals as a function of some personality trait or characteristic. There are additional methods available for structural imaging, such as diffusion tensor imaging (DTI), which allows for measurement of anatomical connections between brain regions. To my knowledge, no studies have used DTI yet to study political differences so I will not discuss that here.

2.2 Functional Magnetic Resonance Imaging

Magnetic resonance imaging can also be used for research on brain function. This type of research uses a different strategy for image collection. While structural imaging produces high-resolution images of the brain, functional imaging typically produces lower resolution images focused not on structure, but on changes in brain function as a prod-

uct of some experimental task. It is important to realize that fMRI relies on *indirect* measurement of brain activation.^{8,9} This measurement of brain function is dependent on what is known as the blood-oxygen-level dependent (BOLD) signal. The basic assumption of fMRI is that measurement of increased cerebral blood flow using the BOLD signal can serve as a proxy for increased neural activity. While this idea is relatively well-established at this point, questions remain about exactly what the BOLD response represents. Neuroscientists have argued that the BOLD response is more closely tied to input and processing within a brain region and less related to output or “spiking” from that region.^{8,9}

There are some important caveats to be aware of related to the interpretation of fMRI data. First, any signal produced is a relative (not absolute) measure of activation. As you will see in the description of political neuroscience work in the sections that follow, typically any results from an fMRI study are discussed in terms of contrast effects (i.e., observing greater activation for one condition compared to a baseline, control, or second experimental condition). Second, analysis of fMRI data is highly dependent on assumptions about the BOLD signal—data is typically analyzed using the hemodynamic response function (HRF), which assumes that the BOLD signal peaks about four to six seconds after stimulus presentation and then returns to baseline.⁹ Finally, fMRI data is correlational—you can show support for a relationship between BOLD activation and stimuli or task demands, but it is difficult to establish causal relationships. Simply showing that brain activation is related to some task does not establish that region is necessary for the task, and researchers who study social or political behavior need to be aware that some of the brain activation they observe may be due to basic cognitive processes (e.g., viewing a stimulus, task switching demands). Careful experimental design can help ameliorate some of these concerns related to interpretation, but it is worth being cautious when interpreting fMRI data.

2.3 Electroencephalography

There is an often discussed trade-off when discussing fMRI versus electroencephalography (EEG) and other neuroimaging methods. While fMRI provides superior spatial resolution, EEG provides superior temporal resolution. This is sometimes mistaken to mean that fMRI provides no information about timecourse, which is not exactly true. Data from fMRI allow for examination of the timecourse on a slower scale—in terms of seconds as opposed to milliseconds with EEG. It is also important to realize that EEG and fMRI are not measuring the same thing—EEG measures electrical activity, whereas fMRI is dependent on the BOLD signal, as discussed above.

The primary strength of EEG is its ability to measure electrophysiological responses in a matter of milliseconds. EEG uses a net of electrodes that is placed on the scalp and measures surface-level electrical activity. The primary difficulty with EEG is determining where those electrical signals are coming from. Although methods for source localization have become significantly more refined over the years, the spatial resolution from EEG cannot compete with spatial resolution obtained through fMRI and it can be difficult to obtain a signal from subcortical regions (e.g., amygdala) using EEG. Most of the work in political neuroscience that I will discuss in this chapter has used structural or functional MRI, but there have also been some studies in this area using EEG, which I will describe below.

3. Important Questions in Political Neuroscience

In the sections that follow, I will provide an overview of political neuroscience research related to four important questions within political psychology: (1) how do people evaluate political information?, (2) how do people think about and process politically similar and dissimilar others?, (3) what is the impact of emotion on politics?, and (4) how do individual differences influence political thought and behavior? For each section, I will provide an overview of the relevant research in political neuroscience, placing this work in the context of social and political psychology, as well as social and cognitive neuroscience. The existing work in political neuroscience becomes easier to interpret if it is placed in context, and a broader understanding of research in these related fields may help to illustrate gaps in the existing work and help generate ideas for future research.

4. Political Attitudes and Evaluation

Social psychologists have been interested in the properties of attitude structure, function, and change for quite some time. Traditional work in this area has relied most heavily on self-reported attitudes, using measurement tools such as Likert scales or semantic differentials, and these were among the first measurement tools to be adopted by political scientists interested in studying attitudes. More recently, there has been a burgeoning interest in implicit or indirect attitude measurement, typically relying on cognitive response latency measures such as the Implicit Association Test (IAT)¹⁰ or the Affective Misattribution Procedure (AMP).^{11,12} Along with these shifts in methodology have been related shifts in attitude theory. Given that we now have two different categories of measurement techniques,

researchers have speculated about what these two types of measures may represent.

In recent years, there has been a lot of debate within social psychology regarding what are known as dual processing and dual systems models of attitudes. Without getting too carried away with the details here, researchers have argued back and forth about whether we should consider implicit and explicit attitudes to be two different types of attitudes (presumably existing as two different types of attitudes stored in the brain or related, to different types of memory or processing)¹³⁻¹⁵ versus a focus on implicit and explicit *measures* tapping into the same attitudinal information (but sometimes producing different “attitudes” at least in terms of measurement outcome).^{16,17} This debate over *dual system* versus *dual process* models of attitudes can potentially be informed by greater understanding of the neural underpinnings of evaluation.

In recent years, social cognitive neuroscience has weighed in on this question by suggesting that we should focus not on different types of attitudes per se, but on the process of evaluation. In a recent model of attitudes and evaluation informed by neurobiology, the Iterative Reprocessing (IR) Model, Cunningham and Zelazo proposed that the process of evaluation should be understood as unfolding over time.^{6,18} Attitudinal information is stored in memory and accessed as needed to provide evaluations relevant to the current situation or context. This process is iterative, meaning that attitudes can be updated as new information is received externally or additional information is accessed internally. So, different “attitudes” may result from implicit versus explicit measures capturing the current evaluation at different time points or after varying degrees of information processing, updating, and reorganization.

The IR Model proposes a network of brain regions that are likely implicated in the process of evaluation, including subcortical regions like the amygdala, insula, and hypothalamus, regions that allow for additional processing, like the anterior cingulate and orbitofrontal cortex, as well as regions likely involved in higher-order processing, such as areas of prefrontal cortex (PFC—dorsolateral PFC, ventrolateral PFC, and rostrolateral PFC).^{16,18} Many of these regions have also been implicated in studies of political neuroscience (see Figure 1 for a visual representation).¹⁹ These regions allow for the integration of sensory information with affective knowledge and are thought to combine to produce an evaluation in any given situation.^{16,18} Importantly, the IR Model can explain potential differences in implicit versus explicit measurement of attitudes by inserting the concept of time. Initial responses are likely to be somewhat rapid and automatic (amygdala, insula), while later responses allow time for regions involved in more reflective processing

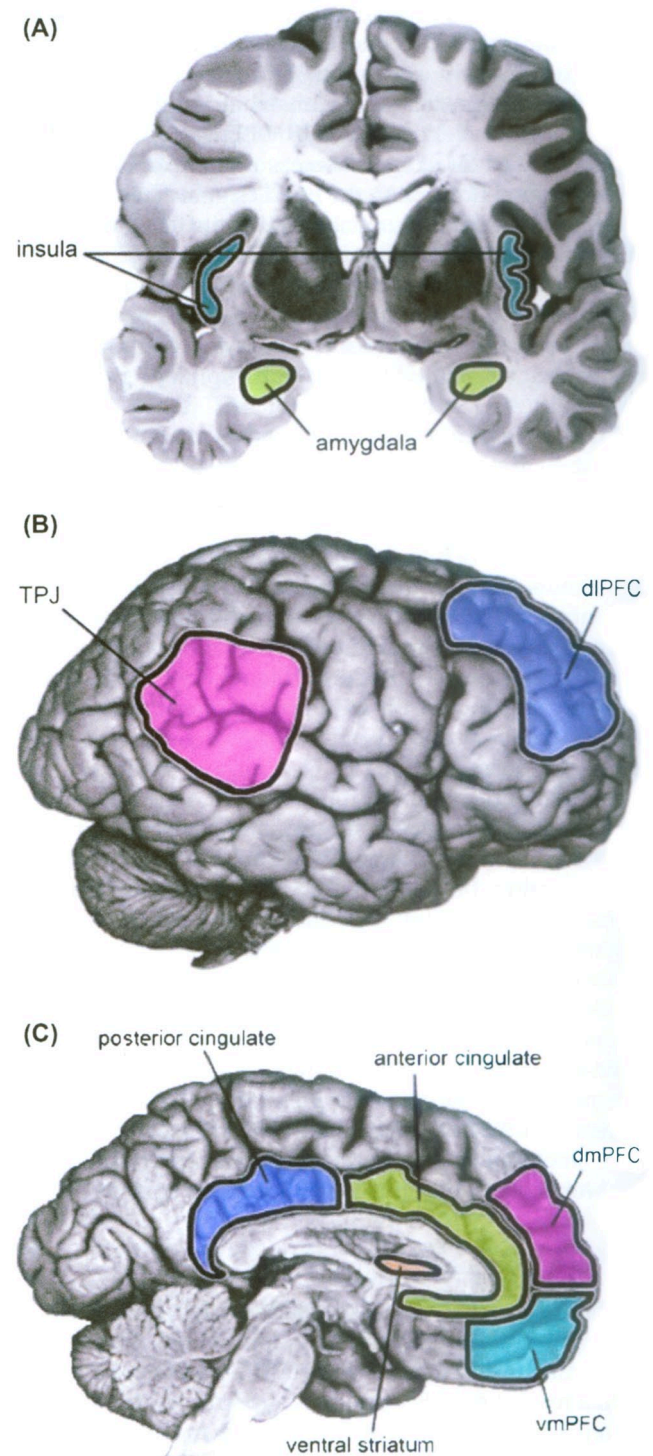


Figure 1. Brain regions and structures that are most commonly observed in studies of political neuroscience: views of (A) coronal, (B) sagittal, and (C) midsagittal planes. Reprinted with permission from Jost et al. 2014 (Ref. 19).

Importantly, recent work in social neuroscience has suggested that we may need to further reevaluate how we think about attitudes. While the distinction between automatic versus controlled processes has been generative for research, it may not be reflective of how the brain actually works. While some processes do happen more rapidly than others, even rapid evaluative processes (e.g., amygdala) are subject to guidance and input from what we would typically think about as more “controlled” systems. Consistent with this view, we have shown that amygdala activation is sensitive to evaluative goals.²⁰ Given that people are constantly monitoring the environment for stimuli and events that are goal congruent or incongruent, it makes sense that even early Signals in the brain are sensitive to this information as well.

4.1 The Psychology of Political Attitudes

Political psychology research on political attitudes and evaluation has focused on similar issues in the context of politics. Many of these debates in political psychology have mirrored debates in social psychology—examining the role of online versus memory-based evaluation, automatic versus controlled processing, and the automaticity of affect. A number of papers, for example, have shown support for the “Hot Cognition Hypothesis,” or the idea that political attitudes are affectively charged and that this affective response is automatically activated upon encountering a stimulus.^{21–23} This theory is somewhat reminiscent of the now infamous debate between Zajonc and Lazarus about the primacy of affect,^{24,25} with Lodge and colleagues coming down on the side of Zajonc, arguing for the primacy of affect. Most of the neuroimaging work in political neuroscience related to attitudes and evaluation has focused on the evaluation of political policies or candidates, both in terms of rapid, automatic processes and slower, more controlled processes.

4.2 Political Evaluation

The amygdala has been implicated in multiple aspects of evaluative processing, including attitudes toward political candidates. One early study in political neuroscience scanned participants while they completed an Implicit Association Test (IAT) using names and faces of well-known Democratic (e.g., Hillary Clinton, Al Gore) and Republican politicians (e.g., Condoleezza Rice, Ronald Reagan).²⁶ Results showed that the amygdala responded to familiar faces, and the strength of the amygdala response was related to the strength of the affective response (positive or negative) toward both parties and candidates. This study also found

fusiform gyrus activation for familiar faces and prefrontal cortex activation for various aspects of the task. While the authors conclude that these results are consistent with a dual processing view of attitudes, I think that is somewhat difficult to discern based on the results of this one study. The prefrontal cortex activation, for example, could have been related to activation of stereotypic knowledge, as they suggest, or more generally related to the cognitive demands of completing a task like the IAT.

More recently, researchers have examined the amygdala response to political candidates across cultures, showing that the amygdala responded more strongly to faces of candidates that participants chose to vote for in samples from both the United States and Japan. However, the results from this study also showed that overall, the amygdala responded more strongly to cultural outgroup members than ingroup members. As with the previous study, the interpretation of these results is somewhat dependent on current theories of the amygdala’s role in evaluative processing.

Historically, the amygdala was thought to respond primarily to negative or fear-inducing stimuli,^{28–30} but more recent work has shown that the amygdala also responds to positive,^{31–33} arousing,³⁴ uncertain,³⁵ or motivationally relevant^{20,36,37} stimuli. Given this ambiguity in terms of amygdala function, the only thing we can really conclude here is that participants probably viewed these candidates as relevant in some way and, given that participants chose to vote for them, we might assume that the amygdala response is related to positive evaluations. However, future work might be able to examine situations where this does or does not hold. From a political science perspective, we know that people sometimes vote because they are excited about their preferred candidate. However, it is also possible that people vote because they are opposed to the candidate from the other party. Given that the amygdala responds to emotional intensity or relevance, it could be the case that this pattern of responding would differ depending on some of these contextual or individual difference variables, but that is speculative at this point.

Other researchers have focused on examining what happens when people view faces of candidates they dislike. For example, Kaplan and colleagues showed participants pictures of the 2004 Presidential candidates’ faces (i.e., George W. Bush, John Kerry, Ralph Nader) during fMRI, demonstrating that when people were viewing opposition candidates, there was greater activation in dorsolateral PFC and anterior cingulate.³⁸ The authors suggest that this activation may be consistent with the idea that participants were engaging cognitive control processes to regulate the negative responses, but because this was a passive viewing task, there is no direct evidence for this hypothesis. Future work could try to test this more directly.

More recent work has shown that this activation in insula and anterior cingulate to disliked candidates is also predictive of election outcomes.³⁹ Real-world candidates (selected from recent Congressional and Governor races) for whom participants showed greater activation in these areas were more likely to lose elections. Importantly, these researchers also showed that negative trait perceptions (i.e., threat) related to this activation were more predictive of election outcomes than positive trait perceptions, suggesting that there may be an overall negativity bias in candidate evaluation. While this is consistent with a variety of work showing evidence for a general negativity bias in evaluation,^{40,41} it is worth noting that this study relied on rapid trait evaluations of candidates. Given more time, it is possible that positive information may have played a greater role in evaluation. In other words, it is possible that part of the reason for the negativity bias is that negative information has some degree of primacy in terms of temporal processing. Indeed, there do seem to be differences in terms of negative versus positive perceptions of ambiguous stimuli leading to activation in more ventral versus dorsal regions within the amygdala.⁴² So, while it is possible that initial, negative perceptions may help drive perceptions of political candidates, it is worth considering the role of both ambivalence and time allowing for correction or modification of these early evaluative responses in future work.

One remaining question here is whether there are differences between active versus passive viewing of political candidates, perhaps being representative of the distinction between automatic versus controlled processing or implicit versus explicit attitudes. Although, it is important to remember that this distinction is likely an oversimplification of how the brain processes information.⁴³ To examine the role of attention, participants in a recent study viewed pictures of German politicians during fMRI and either attended to the pictures or viewed the pictures while completing a demanding visual fixation task.⁴⁴ Politicians represented either the Christian Democratic Union Party or the Social Democratic Party. The researchers could then examine whether brain function differed during active versus passive viewing, and as a function of candidates' party affiliation. When politicians were unattended, they found that regardless of party affiliation, preference for candidates was related to activation in ventral striatum, a region often implicated in reward processing. Preferences for candidates of one's preferred party was related to processing in additional regions, including insula and cingulate cortex (both anterior and posterior regions). This work is consistent with theories in political psychology such as the "Hot Cognition Hypothesis," suggesting that people have a tendency to automatically process political information (i.e., faces of political candidates).

4.3 Motivated Reasoning

Another important question in political psychology has been to examine the role of motivated reasoning. Classic research on attitudes in social psychology, for example, showed that people were able to distort incoming information to be consistent with their prior beliefs, whether they were in favor of or opposed to the death penalty.⁴⁵ Kunda offered a theoretical overview of motivated reasoning, suggesting that people experience conflict between the motivation for accuracy versus the motivation to reach desired conclusions.⁴⁶ More recently, researchers have begun to examine the neural underpinnings of these effects.

In another early study in political neuroscience, Westen and colleagues examined motivated reasoning by asking participants to make judgments during fMRI about information that was threatening to either their own candidate, an opposing candidate, or a neutral control target.⁴⁷ Data was collected from "committed partisans" during the 2004 U.S. Presidential election. The study found behavioral evidence for motivated reasoning, showing that Democrats were more likely to perceive contradictions from George W. Bush and vice versa, Republicans were more likely to perceive contradictions from John Kerry. When participants were engaged in motivated reasoning, a network of regions was involved including ventromedial PFC, anterior and posterior cingulate cortex, insula, and lateral orbitofrontal cortex. Given that many of these regions (e.g., insula, ACC, lateral OFC) are involved in processing negative information, detecting conflict, and integrating cognitive, and affective responses,⁴⁸⁻⁵¹ this overall pattern of results, seems consistent with what we would expect when people are engaged in motivated reasoning. Interestingly, the study also found that when participants were given the opportunity to resolve this inconsistency, activation in ventral striatum was observed. Given that the ventral striatum has often been implicated in reward processing,^{52,53} this is consistent with the view that resolving inconsistency may be experienced as rewarding.

4.4 Attitude Change

While research on motivated reasoning has shown that people often maintain preexisting attitudes through biased reasoning processes, it is important to note that attitudes can and do change in response to new information. Indeed, this was an important part of Kunda's theory—people are also motivated by a desire for accuracy and may abandon desired conclusions if the counter-attitudinal evidence is overwhelming.⁴⁶ Attitude change is more likely to occur when people do not hold strong preferences to begin with, or

when attitudes are weaker or less certain.⁵⁴ Attitudes can become stronger—a positive attitude might become even more positive, or they can change valence—a positive attitude might become a negative attitude, for example. Importantly, given our understanding of attitudes, these positive and negative processes appear to be independent of one another.⁵⁵ So, thinking of an attitude purely as positive versus negative is likely an oversimplification. Attitudes can contain some degree of positive information, negative information, both (ambivalence), or neither (apathy).

Researchers have begun to examine what leads to both positive and negative political attitude change using fMRI. It appears that different regions of the prefrontal cortex may be implicated in positive versus negative change. One study showed that the dorsolateral prefrontal cortex response to negative campaign videos predicted attitude change in a negative direction—lower ratings of a political candidate.⁵⁶ It has been suggested that dorsolateral prefrontal cortex is involved in cognitive control and reprocessing of evaluative information,^{16,18,57} consistent with the idea that it may be involved in attitude change, especially for more abstracted information. The Kato study also showed a relationship between medial prefrontal cortex and increased ratings of candidates.⁵⁶ This may be consistent with a larger body of work, suggesting that medial prefrontal cortex is implicated in Theory of Mind⁵⁸—imagining the mental states of others—and is more likely to occur when thinking about people we like (as opposed to those we dislike).⁵⁹ That work will be described in more detail below.

5. Social Cognition and Politics

The term social cognition means different things to different people, but for the purposes of this chapter I will focus primarily on discussing issues related to Theory of Mind or mentalizing. The overarching question guiding research in this area has been to determine how people think about and make decisions about the behavior of other people.

Research on Theory of Mind has focused on understanding how people think about or “mentalize” about the minds of others. Engaging in this process allows individuals to think about the causes of others’ behavior and anticipate how others will respond to them. At this point, the neural underpinnings of Theory of Mind are fairly well established. Neuroimaging work has primarily focused on the role of the medial prefrontal cortex and temporoparietal junction.^{58,60} Interestingly, recent work has shown that people may deploy this resource somewhat strategically. Kozak and colleagues showed, for example, that people were more likely to engage in Theory of Mind processing for liked versus disliked others.⁵⁹

In the political context, social cognition research has been applied primarily to understanding how people think about political candidates or politicians, although there are also examples of work examining how people think about politically similar or dissimilar others. This work has primarily focused on the role of the medial prefrontal cortex. Mitchell and colleagues hypothesized that people would be more likely to mentalize about politically similar versus dissimilar others.⁶¹ During fMRI, participants were presented with other people who either held similar or dissimilar political views. They found that ventromedial prefrontal cortex activation was greater for similar others, whereas dorsal medial prefrontal cortex activation was greater for dissimilar others. This is consistent with the behavioral work showing that people engage in mentalizing somewhat selectively.⁵⁹

Additional brain regions have been implicated in perspective taking, aside from the medial prefrontal cortex. In an fMRI study conducted immediately prior to the 2008 election, Falk and colleagues showed that taking the perspective of a same party candidate resulted in greater poster cingulate cortex activation, whereas taking the perspective of an opposing candidate led to activation in bilateral temporoparietal junction and insula.⁶² While many of these regions have been implicated in social cognition processes, it is still somewhat unclear why different regions within this network would respond differentially to ingroup versus outgroup targets. Given that there have only been two studies (to my knowledge) on the political neuroscience of perspective taking and Theory of Mind, this area is ripe for future investigation.

6. Emotion and Politics

Political science has had a long relationship with fields like economics that focus more on rational choice models of decision-making. But with increasing interest in psychology and neuroscience, some political scientists have expressed a growing interest in understanding both biases in human information processing and the role of emotion. It is worth noting that it is not necessarily the case that emotion leads to biased reasoning. It certainly can, but it is important to realize that emotion probably exists because it was adaptive. The amygdala’s role in fear detection, for example, likely evolved because it was adaptive for both human and nonhuman animals to prioritize their response to threatening stimuli.³⁷ Disgust is another emotion that is often described in terms of its evolutionary origins.⁶³ Most of the recent work on emotion in social psychology and cognitive neuroscience has focused on trying to understand the structure and function of emotion. Political scientists are interested in emotion insofar as it helps to explain political

behavior. So, the focus for political scientists is more on how emotion influences political evaluation and decision making.

6.1 Social Psychological Models of Emotion

Social psychologists have offered many different theories of emotion over the years, with one potential starting point being the basic emotion models. These models attempted to specify a set of emotions that were both basic and universal—the list typically included the basic six: happiness, sadness, fear, anger, disgust, and surprise.^{64,65} While there is some evidence that the basic emotions map on to facial expressions, the evidence for unique neural substrates for each of these emotions is rather limited, perhaps even nonexistent.^{66,67} A more recent approach to emotion informed by work in affective neuroscience suggests that psychological constructivism is likely the more appropriate approach.⁶⁶ From this perspective, there is a network of brain regions involved in social and affective processes across emotion categories. Given that the basic emotion models may have limited explanatory power, social psychologists have proposed other models of emotion over the years—most can be considered either dimensional or appraisal models of emotion.

Both dimensional and appraisal models have evolved and have become more complicated over time, especially given recent work in affective neuroscience, but I will summarize the basic arguments here. The dimensional models of emotion typically attempt to simplify emotions into two or more dimensions. The most popular version being Russell's Circumplex Model, which includes both valence (ranging from positive to negative) and arousal (ranging from low to high).⁶⁸ These dimensions are orthogonal, so emotions can be positive or negative and high in arousal (e.g., fear, excitement) or low in arousal (e.g., contentment, sadness). From this perspective, it is important to consider both valence and arousal when examining the role of emotions—to see if the impact of a given emotion is; due to its valence, arousal, or some interaction of the two.

Appraisal models of emotion have focused more directly on the cognitive processes that give rise to the experience of emotions—suggesting that emotions are constructed to help people deal with specific types of situations and respond appropriately. Appraisal models have taken different forms over the years, but typically suggest that people have some sort of physiological or affective response, which then gets interpreted in light of the current situation or context and then gets labeled as a specific emotion.²⁵ This view is probably most consistent with the psychological constructivism approach advanced by scholars like Lisa Feldman Barrett.^{66,67} Indeed, some of the newer appraisal models are directly informed by research on affective and computational neuroscience.⁶⁹

Importantly, the appraisal models have helped to elucidate the idea that emotions, which may look similar in dimensional models, may actually have distinct behavioral outcomes. For example, fear and anger are both high-arousal negative emotions but have been shown to lead to different outcomes in relation to risky behavior.⁷⁰ In general, fear is more likely to lead to avoidance behavior, whereas anger is more likely to lead to approach behavior.⁷¹ Research on emotion and politics has only just begun to incorporate and adapt these models of emotion to increase our understanding of political behavior.

6.2 Models of Emotion and Politics

Political scientists have begun to incorporate models of emotion into their research, but I think it is fair to say that there is still much work to be done in this area. Early work in the area of emotion and politics focused on positive versus negative emotions, largely assuming that all negative emotions should lead to similar outcomes. However, consistent with dimensional or appraisal models of emotion discussed above, the work in political psychology has increasingly shown that emotions cannot be collapsed into a simple valence dimension, and even emotions that look similar in terms of a dimensional analysis—fear and anger, for example—lead to different outcomes in political behavior.^{72,73} There have been some attempts to synthesize the current state of research on emotion and politics, and interested readers may want to review edited volumes such as *The Affect Effect* for more background.⁷⁴ I will give a brief overview of some of the recent work in political science below.

Research on emotion and politics has shown that positive and negative emotions have differential impact on politics, but also that different negative emotions may have different outcomes. For example, building on appraisal models of emotion, Huddy and colleagues have attempted to distinguish among anxiety, anger, and threat, showing that each of these emotions has distinct connections to foreign policy preferences.^{75,76} Other work has examined how these emotions are connected to candidate appraisals and voting behavior, showing that emotions like hope and anger may be most likely to lead to voter mobilization.⁷⁷ In contrast, emotions like anxiety may be more likely to lead people to abstain from voting or reconsider their options and switch sides.⁷⁸ At this point, there is only one major theory of emotion and politics that has been put forth, and I will outline that theory below.

One of the primary theories in political science of how emotion influences politics is the Affective Intelligence Theory (AIT).^{78,79} Marcus and colleagues have argued for this theory on the basis of neurobiological models of affect, suggesting that there is an important distinction to be made

between behavior in familiar versus unfamiliar contexts. When objects or situations are familiar, people can rely on preexisting attitudes and beliefs to guide behavior either toward (for appetitive stimuli) or away (for aversive stimuli) from that stimulus. When situations are unfamiliar, AIT argues that people will experience greater anxiety and engage in additional information search in order to gain the information necessary to direct behavior in that situation. From this perspective, political scientists have shown support for the idea that anxiety leads to increased attention and political learning,⁸⁰ consideration of opposing viewpoints, and willingness to compromise.⁸¹ While this may be consistent with some of the research on uncertainty in social psychology and cognitive neuroscience, it is largely inconsistent with the large body of work linking uncertainty (and anxiety) to threat, suggesting the interplay of these affective states may be more complicated than initially assumed.

From a motivational perspective, uncertainty can serve as a signal that we are lacking enough information to deal with situational challenges appropriately.⁸² While informational uncertainty may sometimes lead to an increase in epistemic motives, other types of uncertainty (e.g., personal uncertainty) may be inherently more threatening and lead to the opposite response—increased closed-mindedness.⁸³ One way to examine this question is to treat uncertainty and threat as distinct conceptual variables (see Figure 2). Threat can be understood as the potential for harm, whereas uncertainty is often more ambiguous and context-dependent, signaling any lack of information or clarity on some issue.^{84,85} From this perspective, uncertainty and threat interact to produce distinct affective states that may then lead to distinct behavioral outcomes.

In some of our work, we hypothesized that the effects of uncertainty on political tolerance would differ as a function of context—namely, whether the uncertainty was associated with threat or not (see Figure 3).⁸⁴ In an experimental context, we found that threat moderated the impact of uncertainty on political tolerance. Uncertainty increased tolerance in a neutral or positive context, but decreased tolerance in a threatening context. In a more recent study, I found support for a similar pattern of results with respect to support for compromise—uncertainty increased support for compromise in a relatively neutral or positive context, but had no effect on support for compromise in a more threatening context.⁸⁶ We are currently investigating the neural underpinnings of this interaction, both in terms of basic affective processes and political information processing. Preliminary analyses have shown that the amygdala, for example, responds differentially to uncertainty associated with negative versus positive affective information.⁸⁵

I have included a section about emotion and politics here not because there is a wealth of neuroimaging research on the topic, but because I think there should be. This is an

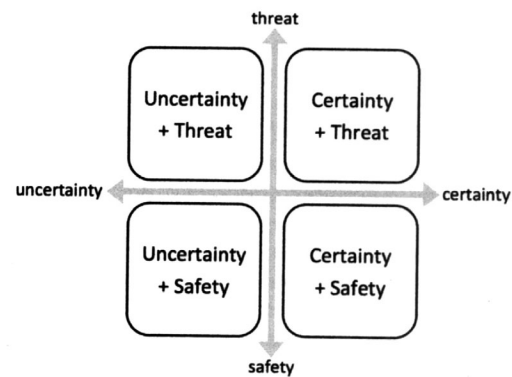


Figure 2. Conceptual relationship between uncertainty and threat. Reprinted with permission from Haas et al. 2014 (Ref 84).

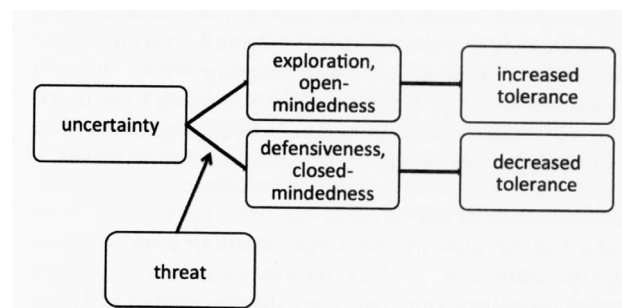


Figure 3. Hypothesized relationship between uncertainty and political tolerance as a function of threat. Reprinted with permission from Haas et al. 2014 (Ref 84).

area of research where neuroimaging methods may be useful, and there is plenty of opportunity in terms of available research questions. It is important to realize that the future goals of this research are unlikely to be quite so simple as mapping the neural pathways that differentiate basic emotional responses. I think a more useful approach, at least in terms of the implications for politics, will be to focus on examining how different emotional experiences change political information processing. While existing research in this area is limited, there has been a fair amount of work examining individual differences in response to affective stimuli, primarily between political liberals versus conservatives. In the following section, I will provide an overview of political neuroscience research on individual differences.

7. Individual Differences in Political Behavior

One of the questions that fMRI is well-suited for is asking whether brain function differs across different types of people. Work in political neuroscience has taken advantage of this to examine differences in social and affective process-

ing as a function of individual differences in political ideology, values, and political interest and expertise.

7.1 Ideological Differences

Ideological differences has been one of the primary topics guiding neuroimaging work on politics. The growth of political neuroscience studies on this topic is likely related to increased interest in both psychological and biological differences between liberals and conservatives. In 2003, Jost and colleagues published a meta-analysis arguing that conservatism has motivational underpinnings, primarily related to differential response to negative or threatening information.⁸⁷ Recent work in the area of biopolitics has largely corroborated this idea, showing that conservatives and liberals differ in their physiological response to negatively valenced emotional stimuli.^{88–92} The relevant neuroimaging work has used both structural and functional neuroimaging to examine the neural underpinnings of these psychological and biological differences between liberals and conservatives.

7.1.1 Brain Structure

Given the growing evidence of a link between biology, genetics, and ideological differences, one possibility is that liberalism versus conservatism is related to differences in brain structure. Consistent with this idea, one study has shown structural brain differences between liberals and conservatives. Kanai and colleagues used structural MRI to examine gray matter volume, finding that liberals had increased volume in the anterior cingulate cortex, whereas conservatives had increased volume in the right amygdala, left insula, and right entorhinal cortex (see Figure 4).⁹³ While this work supports the hypothesis that liberals and conservatives have different brain structure, there are multiple ways to interpret this data and I think some caution is warranted, given that this is just one study.

First, it is probably necessary to consider whether or not these structural differences are indicative of functional brain differences. It is not necessarily the case that having more gray matter in a region means you will find significant differences in function, but it does mean that these brain regions are probably worth examining in subsequent studies of brain function. While this is purely speculative at this point, the amygdala finding from the Kanai study could be consistent with behavioral work suggesting that conservatives are more sensitive to threat or negativity than liberals.^{87,89,94} However, it is important to note that the relationship between amygdala activation and fear or negativity is not a one-to-one mapping. While the amygdala has been implicated in fear, it has also been implicated in responses to positive or arousing information, as discussed earlier in this chapter.^{31–33} More recent theorizing about amygdala

function has suggested that the amygdala response is not specific to positive or negative information per se, but that the amygdala may respond to any information that is motivationally relevant for the individual.⁹⁵

Second, structural differences are also difficult to interpret because there is sometimes an assumption that they are an indicator of biological or genetic differences in brain growth or development (suggesting the influence of nature over nurture). An alternative, or perhaps complementary, viewpoint is that brain structure is influenced not just by biology and genetics, but also, by psychology and behavior. For example, some recent longitudinal work has shown that a stress-reduction intervention actually reduced both reported stress level and gray matter volume in the right basolateral amygdala.⁹⁶ So, having a larger amygdala might increase sensitivity to stress, but a decrease in stress may also decrease the size of the amygdala. Jost and colleagues have labeled this the “chicken-and-egg” problem in political neuroscience.^{19,89} It could be the case that genetic differences shape brain structure in a way that gives rise to ideological differences, or it could be the case that people adopt certain patterns of behavior and that behavior then shapes brain structure. In reality, brain structure is probably determined by some combination of these two perspectives. The take-home point is that we need to be careful about assuming causal relationships from studies of brain structure. Regardless of the causal pathways, the Kanai study⁹³ suggested to researchers that these regions (e.g., the amygdala and anterior cingulate) are worth examining in future studies of ideology, brain structure, and brain function.

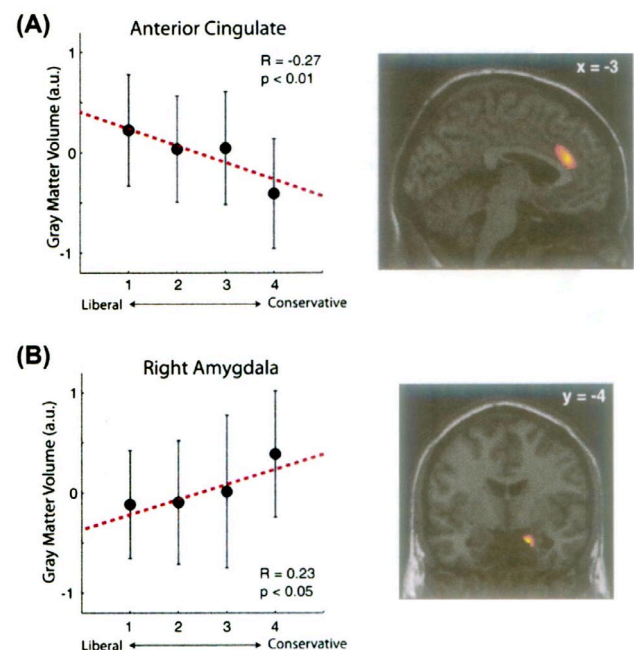


Figure 4. Individual differences in political attitudes and brain structure. Reprinted with permission from Kanai et al. 2011 (Ref 93).

7.1.2 Brain Function

Research on whether or not brain function differs between liberals and conservatives is still relatively limited, but the existing research is consistent with the idea that there may be processing differences in regions implicated in social and affective processing—such as the amygdala, insula, and anterior cingulate. One recent study showed that during a decision-making task, Democrats showed greater activation in the left insula and Republicans showed greater activation in the right amygdala.⁹⁷ Interestingly, while brain function appeared to differ, the decisions participants made in this study did not. In other words, it could be the case that these differences are due, at least in part, to differences in the decision-making *process* as opposed to the outcomes. This conclusion should be treated as tentative at this point, given that this is just one study and other research has shown that there may be differences in both process and outcomes. Using EEG, Amodio and colleagues found that liberals demonstrated greater conflict-related activity and were more accurate on a go/no-go task.⁹⁸ The conflict-related activity on no-go trials was localized to the dorsal anterior cingulate cortex, which is one of the regions where structural differences between liberals and conservatives have been found.⁹³ Taken together, these studies suggest that there may be functional differences between liberals and conservatives in some of the regions where structural differences were previously found—the amygdala, insula, and anterior cingulate.

A lot of the recent behavioral work or work in biopolitics has focused on ideological differences in emotional responding, suggesting that liberals and conservatives may differ in their response to negatively-valenced emotional stimuli.^{88,89} Only one study (that I am aware of) has examined this question using neuroimaging. Ahn and colleagues had participants engage in a passive viewing task during fMRI using stimuli (emotional images) from the International Affective Picture System (IAPS).⁹⁹ Consistent with behavioral work showing that conservatives are more responsive to disgust,^{91,100} conservatives in this study appeared to be more sensitive to disgusting images (especially those images related to animal mutilation). Liberals showed greater activation than conservatives to disgusting stimuli mainly in the insula, whereas for conservatives, there was greater activation for this contrast (disgust > neutral) in a whole network of regions, including the amygdala, hippocampus, basal ganglia, thalamus, anterior cingulate, dorsolateral prefrontal cortex, and ventromedial prefrontal cortex. While this is consistent with the view that conservatives may be more sensitive to disgusting stimuli than liberals, it is difficult to conclude what processes each of these regions may have been engaged in, given that this was a passive viewing task. Future work may want to examine differences be-

tween liberals and conservatives using different tasks that require additional processing demands (e.g., emotion regulation). It could be the case that liberals and conservatives respond differently to disgusting images, or they might differentially engage emotion regulation strategies to cope with the disgust response.

While a growing body of work has suggested that conservatives may be more sensitive to negative information than liberals,^{87,99} one alternative perspective is that conservatives are more sensitive to arousal (and not negativity, *per se*).^{89,101} From the perspective of dimensional models of emotion (see earlier section on Emotion and Politics), it is important to consider both the valence of emotions and their level of arousal. If researchers are comparing high-arousal negative emotions to low-arousal positive emotions, any observed differences could be due either to valence (negative-positive) or arousal (low-high). It is important to note that the Ahn study did not examine differences between negative versus positive emotions directly, and the positive images used in the study appear to be lower in arousal (e.g., animals, babies) than the negative images used (e.g., snakes, violence, mutilation).⁹⁹ So, the question about whether conservatives are more responsive to negative or highly arousing stimuli, even when positively valenced, remains.¹⁰¹ To examine this question directly, researchers will need to compare emotional responses to positive and negative stimuli while controlling for, equating, or manipulating arousal.

7.2 Values

An alternative approach to understanding ideological differences in brain function has been to examine differences in neural processing related to specific values that might underlie ideological differences. This research builds on a long tradition in psychology and political science of studying values as a way to understand political attitudes.¹⁰² Political ideology has been most closely tied to values related to preference for tradition versus change and views about equality.¹⁰³ Neuroimaging work has attempted to examine the brain activity that might underlie political decision-making related to these values, although this work has been largely exploratory.

Zamboni and colleagues had participants evaluate political beliefs during fMRI and examined the relationship between evaluative processing and values—individualism, conservatism, and radicalism.¹⁰⁴ They found differentiation on the basis of these values: individualism was related to activity in the ventromedial and dorsomedial prefrontal cortex and temporoparietal junction, conservatism was related to the dorsolateral prefrontal cortex, and radicalism was re-

lated to the ventral striatum and posterior cingulate. While this research does suggest that values may be related to differential processing of political statements, it is still unclear why these differences are occurring or how they map on to differences in the process of decision-making. The authors do speculate about what this activation might mean—perhaps individualism-related prefrontal cortex activation signals self-referential processing, dorsolateral prefrontal cortex activation might be related to additional evaluative processing for liberals versus conservatives, and radicalism might be related to greater emotional responses to these statements.¹⁰⁴ It is important to note, however, that these assumptions are based on reverse inference and may or may not be corroborated by future work. Additional work will be needed to test these assumptions directly.

A second study on this topic focused on the role of egalitarianism, showing that egalitarian preferences during a decision-making task were related to activation in the insula and ventromedial PPC.¹⁰⁵ The insula has been implicated in a number of studies related to emotion and empathy, or just more general integration of bodily states, so this connection between insula activity and egalitarianism seems plausible. But again, more work will be needed to clearly examine the underlying mechanisms here.

7.3 Political Interest and Expertise

Another important individual difference that has often been discussed by political scientists is the distinction between political experts versus novices. The classic research in political science often discussed differences between the mass public versus political elites, often arguing that political elites were really the only individuals with something that resembled a political ideology.¹⁰⁶ This question has also been examined through the use of neuroimaging methods, looking primarily at differences between political experts versus novices or people who are highly interested in politics versus uninterested.

Interestingly, while the impact of expertise on brain function has often been discussed in a cold, cognitive sense, purely in relation to knowledge, it may be the case that there is a motivational component as well. In other words, some people may actually be motivated to learn or read about politics and may experience that activity as rewarding. Consistent with this view, Gozzi and colleagues showed that individuals with a strong interest in politics experience greater activation in the amygdala and ventral striatum (putamen) when reading statements they agreed with.¹⁰⁷ While we need to be careful about making reverse inferences here, this is consistent with the idea that viewing these positive statements may be rewarding for individuals interested in politics. Interestingly, this may help explain why some political junkies literally cannot stop reading about or watching the news.

8. Directions For Future Research

The field of political neuroscience is relatively young, and research in this area is fairly limited at this point. While this makes it difficult to generalize and draw broader conclusions based on the work, I think we do have enough at this point to say that neuroimaging has the potential to inform research in political psychology and biopolitics. The challenge for researchers then becomes figuring out how we should move forward in this interdisciplinary area. Below, I offer some suggestions for researchers currently working in the field of political neuroscience, or those who are interested in getting involved in this work.

Most, if not all, of the political neuroscience studies described here have been exploratory in nature. There is nothing inherently wrong with this, given that exploratory research is often the first stage of a larger research program—gathering initial data on important questions can help clarify theory and generate hypotheses for subsequent research. However, I do think we are getting closer to the point where we can move out of the initial exploratory phase and into the hypothesis-testing phase.

The main problem with exploratory fMRI studies is that they are difficult to interpret, for a number of reasons. As discussed at the outset of this chapter, fMRI data is correlational. It is difficult (if not impossible) to demonstrate causal relationships using fMRI data. The bigger issue with these exploratory studies is that interpretation has largely relied on reverse inference and assumptions about the processes that participants were engaged in during the task. Now that some of this initial work has been conducted, we can start to develop more nuanced hypotheses about how people are processing political information and why we are observing brain activation in specific regions or networks. Given that we have specific hypotheses about brain mechanisms, we can carefully design experimental tasks to test these mechanisms by directly manipulating or measuring variables of interest. Only through careful experimentation can we determine, for example, why the amygdala is responding to political candidates, how the amygdala is involved in political evaluation, how this differs across individuals, and what the boundary conditions are that limit or constrain these effects.

It would be impossible to overemphasize the importance of careful research design in the fMRI environment. In an ideal world, any political neuroscience study using fMRI would include the following: theoretical background, specific hypotheses about brain function, behavioral pilot data, careful experimental design with multiple conditions, task data during scanning (as well as relevant postscan ratings), measurement of relevant individual differences, and great care taken when drawing conclusions not to overgeneralize or rely on unwarranted reverse inferences about brain

function. Other scholars have offered similar suggestions for those working in the field of political neuroscience,⁷ as well as those working in social and affective neuroscience more generally.¹⁰⁸

It is worth noting here that there is a relatively steep learning curve when it comes to learning neuroimaging methods such as fMRI, so collaboration among interdisciplinary teams should be encouraged. Political scientists interested in working in the area of political neuroscience will likely benefit from working with social and cognitive psychologists, who have expertise in experimental design, as well as social and cognitive neuroscientists, who have expertise in conducting research within the MRI context and dealing with unique considerations for both experimental design and data analysis. Psychologists and neuroscientists interested in politics can benefit from working with political scientists, who have expertise in the role of context and are more well-versed in issues related to external validity. Many fMRI studies, especially early studies using this methodology, have relied on very small sample sizes, typically with convenience samples. I think future studies in political neuroscience will probably want to move toward collecting data from larger, more diverse samples and attempt to use that data to predict real-world outcomes, in addition to performance on experimental tasks. These are ambitious goals and might be difficult for any lone scientist to master but will likely be easier to tackle in larger, interdisciplinary teams.

There is one very good reason why fMRI studies have typically relied on small sample sizes—cost. Given the expense attached to doing research using fMRI (as of this writing, an hour of scan time typically costs around \$500 or \$600 at universities in the US), the challenge for researchers becomes trying to figure out if and when fMRI will be a valuable method to add to their toolbox. Many questions in political science may not require the use of methods like fMRI, and researchers should not feel obligated to use these methods if they are not directly relevant to the questions they are interested in. fMRI is most likely to be a useful tool when researchers have ideas about processes or mechanisms that give rise to observable political behavior and are interested in testing whether or not those mechanisms are tenable given neurobiological structure and function.

9. Conclusion

Neuroimaging cannot replace traditional methods and measurement techniques in political science, but it can serve as a useful technique for examining whether or not theories about political behavior are biologically plausible. Social psychology has demonstrated over the years that people have many assumptions about human behavior that are not always supported at the behavioral level, and the same is

likely true for what neuroimaging can show us at the neural level. For example, neuroscience work has already led many scientists to question some of the traditional assumptions that have guided research on social behavior in recent decades—that emotion and cognition are distinct processes, or that implicit versus explicit attitudes are categorically distinct and stored separately in memory—and it will likely lead us to question many other assumptions about human behavior. We have really only just begun trying to use neuroimaging methods to understand how people make social and political decisions at the neural level, and it will likely be the case that, in the years to come, we will continue to learn that our current theories of human social and political behavior are incomplete.

In sum, while research in political neuroscience has increased rapidly in recent years, we still have a long way to go before we have a clear picture of the neural mechanisms that underlie political evaluation, cognition, and decision-making. While this means there are still a number of challenges for researchers working in this area in terms of methods, design, and interpretation, it also means it is an exciting time for anyone interested in the subfield of political neuroscience, either as a participant or an observer. It is an area of research where there is still much left to explore.

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