

## Political Neuroscience: The Beginning of a Beautiful Friendship

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*The emergence of political neuroscience—an interdisciplinary venture involving political science, psychology, and cognitive neuroscience—has piqued the interests of scholars as well as the mass public. In this chapter, we review evidence pertaining to four areas of inquiry that have generated most of the research in political neuroscience to date: (1) racial prejudice and intergroup relations; (2) the existence of partisan bias and motivated political cognition; (3) the nature of left-right differences in political orientation; and (4) the dimensional structure of political attitudes. Although these topics are well-known to political psychologists, the application of models and methods from neuroscience has renewed interest in each of them and yielded novel insights. There is reason to believe that many other areas of political psychology await similarly promising renewals and that innovative methods will continue to advance our understanding of the physiological processes involved in political cognition, evaluation, judgment, and behavior. We address limitations, criticisms, and potential pitfalls of existing work—including the “chicken-and-egg problem”—and propose an ambitious agenda for the next generation of research in political neuroscience.*

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“It is evident that the state is a creation of nature, and that man is by nature a political animal.”

—Aristotle

One of the most trenchant social and political psychologists of the twentieth century, William J. McGuire (1993), observed that the “politics and psychology relationship has been lively and

long-lasting as interdisciplinary affairs go, its longevity fostered by frequent shiftings of its popular topics, methods, and theories” (p. 363; see also Jost & Hardin, 2011). As in all sustainable relationships, psychology and political science have, for the most part, changed together rather than grown apart (e.g., see Huddy, Sears, & Levy, 2013; McGuire, 1993; Sears, Huddy, & Jervis, 2003). Perhaps it was inevitable, then, that political scientists would come to share psychologists’ enthusiasm for the models and methods of neuroscience, including the use of electroencephalography (EEG), magnetic resonance imaging (MRI), and other measures of the central and peripheral nervous system (e.g., Alford & Hibbing, 2008; Amodio, Jost, Master, & Yee, 2007; Carmen, 2007; Fowler & Schreiber, 2008; Schreiber et al., 2013; Smith, Oxley, Hibbing, Alford, & Hibbing, 2011b; Taber & Young, 2013; Theodoridis & Nelson, 2012).

Political neuroscience is an interdisciplinary venture that tackles questions of mutual interest to political scientists and psychologists by drawing, at least in part, on the theories, methods, and assumptions of biology, especially neuroscience. The application of neuroscience to political topics offers a powerful set of research methods that promises to integrate multiple levels of analysis. As E. O. Wilson (1998) wrote in *Consilience: The Unity of Knowledge*: “the social sciences are intrinsically compatible with the natural sciences. The two great branches of learning will benefit to the extent that their modes of causal explanation are made consistent” (p. 205). Through techniques such as neuroscience and behavioral genetics, it may be possible to analyze complex phenomena in terms of underlying constituent mechanisms and processes (see also Cacioppo & Berntson, 1992).

Budding enthusiasm for the use of neuroscientific methods to examine questions at the intersection of psychology and politics was obvious enough that several commentators predicted the emergence of political neuroscience (Cacioppo & Visser, 2003; Lieberman, Schreiber, & Ochsner, 2003; Marcus, 2003)—three years *before* the first *bona fide* empirical publications actually appeared (Knutson, Wood, Spampinato, & Grafman, 2006; Westen, Blagov, Harenski, Kilts, & Hamann, 2006). Cacioppo and Visser (2003) noted that “neuroscientists and political psychologists [were] not strange bedfellows,” nor were they “comrades in arms” (p. 647) and—consistent with Wilson’s (1998) views about consilience—anticipated that neuroscientific contributions would “build on rather than substitute for the extant theory and methods in political psychology” (p. 655). To date, a genuinely collaborative stance between political psychology and neuroscience has been maintained in theoretical and empirical work. As a result, the coming together of politics and neuroscience has been fruitful and mutually beneficial—both contributing to established theories in social and political psychology (Jost & Amodio, 2012) and inspiring brand new theoretical perspectives (Hibbing, Smith, & Alford, *in press*). As Taber and Young (2013) pointed out, the field is experiencing “an exciting turning point” in which researchers are “looking inside the black box already” (p. 549).

The use of neuroscientific methods to examine questions of political psychology brings with it clear advantages in terms of technical sophistication and relatively precise, objective measurements that are less subject to social desirability and self-presentational biases, in comparison with research that depends upon methods of self-report (such as public opinion surveys). Different techniques, it should be noted, have their own strengths and weaknesses, and so some methods are better suited for certain theoretical purposes than others. So far, fMRI is one of the most commonly used techniques in political neuroscience. It has high spatial resolution and is therefore well-equipped to represent neural activity in distinct brain regions: It is useful for addressing questions of the form *where in the brain is X process instantiated?* At the same time, the temporal resolution of fMRI is low, making it far from ideal for answering questions about the timing and sequence of processing stages (see also Theodoridis & Nelson, 2012). Furthermore, the equipment is extraordinarily bulky and expensive, and participants are required to immobilize themselves in a loud, claustrophobic environment while their brains are scanned. For many scientific purposes, EEG provides a much less expensive and more convenient option that brings high temporal resolution (but low spatial resolution), making it especially useful for measuring the time course of a given psychological process.

Our enthusiasm about the promise of political neuroscience should not be taken as Pollyannaish when it comes to the (indiscriminate) use of neuroscientific methods to tackle complex questions about social and political behavior. Cognitive neuroscientists are quick to acknowledge that there are limits to what can be inferred about the mental states and processes of individual actors solely on the basis of brain activity and anatomical structure (e.g., Cacioppo et al., 2003; Poldrack, 2006; Thomas & Baker, 2012), and political neuroscientists, too, are advised to proceed with caution (Jost & Amodio, 2012; Theodoridis & Nelson, 2012). Our review of the literature reveals that most studies thus far have concentrated simply on “brain mapping,” that is, seeking to identify correlations between neural functions (or region-specific activation) and political attitudes and behaviors. This is a necessary step in the research process, but it is also important to bear in mind problems associated with the drawing of “reverse inferences,” that is, concluding that because a given brain region (e.g., the amygdala) is generally involved in a certain type of task or function (e.g., the processing of emotionally salient information) that its activation in a given instance must indicate the presence of a specific mental process (e.g., the experience of emotion). As Poldrack (2008) has pointed out, the method of reverse inference provides only weak evidence concerning the operation of specific mental processes “because of the fact that activation is rarely selective,” insofar as “regions are often activated by a wide range of mental tasks” (p. 224). The subfield of political neuroscience will have truly come of age when the knowledge gained from brain-mapping studies is parlayed successfully into hypothesis-driven tests of behavioral as well as neurological outcomes specified by process-oriented theories in political psychology (see also Amodio, 2010a). Steps have indeed been taken in this direction, as our review will show, but it is worth emphasizing that these are still early days for political neuroscience—the “beginning of a beautiful friendship,” so to speak.

In the remainder of this article, we review four areas of empirical inquiry that account for most of the publicly available research in political neuroscience: (1) racial prejudice and intergroup relations; (2) the existence of partisan bias and motivated political cognition; (3) the nature of left-right differences in political orientation; and (4) the dimensional structure of political attitudes. All of these topics are well-known to political psychologists (e.g., Feldman, 2013; Huddy et al., 2013; Jost & Sidanius, 2004; McGuire, 1985, 1993; Sears et al., 2003; Taber & Lodge, 2006; Tetlock, 2007)—and yet the application of neuroscientific methods has breathed new life into each of them. We have little doubt that many other research areas await similarly promising renewals. Because the alliance between politics and neuroscience is so new, our review can afford to be brief and forward-looking but also reasonably comprehensive.

### **Racial Prejudice and Intergroup Relations**

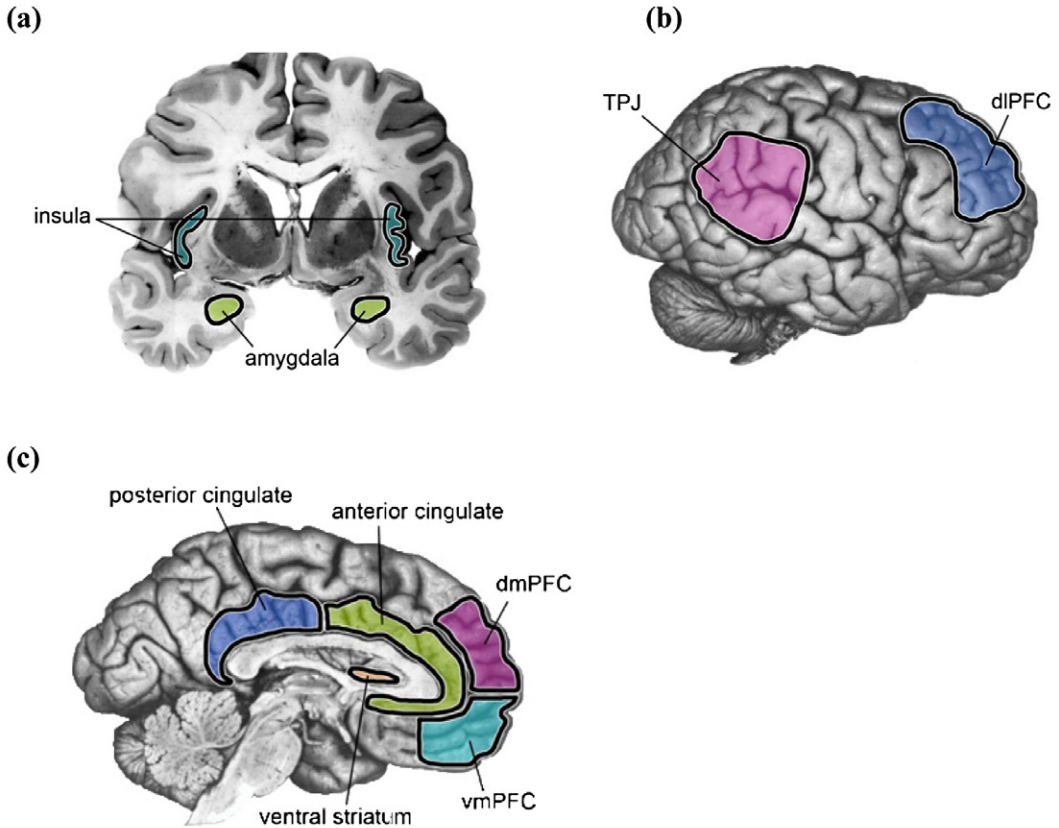
From the earliest days of American slavery through the Civil Rights era and beyond, racial themes have frequently dominated the political landscape. Thus, it is no surprise that the study of both subtle and blatant forms of racial prejudice (and their implications for intergroup relations as well as electoral politics) constitutes a major area of political psychology (e.g., Mendelberg, 2001; Sears et al., 2003; Valentino, Hutchings, & White, 2002). Of particular interest is the question of whether racial resentment (of one kind or another) continues to influence social and political outcomes (see Sears, Sidanius, & Bobo, 2000). There is by now a well-developed research literature on the neural processes involved in racial categorization and prejudice, as well as intergroup relations in general. Because of increased professional specialization and the thickness of disciplinary boundaries, advances in social cognitive neuroscience have been slow to reach political psychology. In an effort to expedite the transfer of knowledge, we recount the history of research on physiological indicators of racial attitudes before turning to some of the more recent breakthroughs afforded by neuroscience methods. Prejudice-related research in social and cognitive neuroscience, which preceded neuroscientific studies of explicitly political cognition and behavior by five or six years,

provides a solid foundation for many of the ideas and techniques that are now being applied to other questions about society and politics, and it clearly demonstrates the promise that neuroscience holds for political psychology.

Some of the very earliest psychophysiological explorations of social behavior, which were conducted in the 1950s, focused on White Americans' responses to reminders of racial differences. In these studies, researchers used nonverbal methods to assess Whites' emotional responses while they were exposed to Black interaction partners or to statements invoking racial or other political views that deviated from those held by the participants (for a review, see Guglielmi, 1999). In one series of studies, for instance, highly prejudiced Whites who heard Blacks described in a favorable light exhibited increased physiological arousal (Cooper & Siegel, 1956; Cooper & Singer, 1956), which was assessed in terms of the skin conductance response (SCR)—sweat gland activity (i.e., the sweating of palms) that is associated with activity of the sympathetic nervous system (see Bradley, Cuthbert, & Lang, 1990). The authors argued, on the basis of these results, that prejudiced attitudes were “emotionally fortified”—that is, deeply ingrained in affective processes—and that exposure to contradictory opinions about racial out-groups created emotional conflict. In another study, participants completed a bogus experimental task in which two different experimenters—one White and one Black—entered the participant chamber at different times, ostensibly to check the electrode connections on the participant's hand (Rankin & Campbell, 1955). In fact, this was a ruse that allowed the experimenters to interact with and even touch the wrist of the participants while skin conductance was recorded. Although White participants reported that they *liked* the White and Black experimenters equally well, they exhibited larger SCRs when interacting with the Black experimenter. This was one of the first studies to suggest a possible dissociation between verbal and nonverbal reactions to racial stimuli, raising the prospects that participants were either concealing or unaware of their prejudices (cf. Devine, 1989). Because of the groundbreaking work of that era (see also Allport, 1954), subsequent generations of researchers have made great strides in understanding physiological and other nonverbal manifestations of intergroup bias and its consequences (e.g., Dovidio, Hebl, Richeson, & Shelton, 2006). Methodological innovations in neuroscience have proven especially useful in this general endeavor (for reviews, see Amodio, 2008; Cunningham & Van Bavel, 2009; Derks, Scheepers, & Ellemers, 2013; Ito & Bartholow, 2009; Kubota, Banaji, & Phelps, 2012).

### *Neural Basis of Prejudice and Stereotyping*

Current investigations focus on the neural correlates of intergroup social cognition, especially when it comes to implicit (as compared with explicit) processes involved in stereotyping and prejudice. This ground was first settled in pioneering studies by Hart et al. (2000) and Phelps et al. (2000), both of which used functional MRI (fMRI) to measure White participants' brain activity while they viewed faces of Whites and Blacks. The goal of these studies was to determine whether the amygdala—an almond-shaped structure located bilaterally in the medial temporal lobes that plays an important role in classical fear conditioning (Davis, 1992; Fendt & Fanselow, 1999; LeDoux, 1996; see Figure 1a)—is involved in implicit racial bias. Neither study revealed an overall difference in amygdala activity as a function of exposure to own-race versus other-race faces, but this null result may be attributable to a methodological constraint (the fact that White and Black faces were presented in separate blocks of trials). More importantly, Hart and colleagues (2000) observed that amygdala activity was slower to habituate to own-race than other-race faces, and Phelps and colleagues (2000) discovered that amygdala activation following exposure to Black (vs. White) faces was correlated with individual differences in implicit racial bias. (In Table 1, we have listed and described brain structures and functions that have been found to correlate with social and political behavior in the studies reviewed in this chapter).



**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.

Amodio, Harmon-Jones, and Devine (2003) considered the theoretical implications of conceiving of the amygdala as a neural substrate of implicit racial bias and focused on the startle eyeblink response—a physiological index of amygdala activity—in response to the presentation of faces of White and Black people. The startle eyeblink method has been used (1) to index the specific subregion of the amygdala that is associated with the expression of fear and (2) to measure changes in amygdala activity within milliseconds after a stimulus is presented, thereby tapping into processes that operate rapidly (Davis, 2006; Lang, Bradley, & Cuthbert, 1990). Using this approach, Amodio and colleagues (2003) observed a significant increase in amygdala activity immediately following exposure to Black (vs. White) faces, thereby linking implicit racial responses to a neural mechanism of fear processing. This pattern—of greater amygdala activity in Whites’ responses to Black than White faces—has now been replicated in several fMRI studies (e.g., Cunningham et al., 2004; Krendl, Macrae, Kelley, Fugelsang, & Heatherton, 2006; Lieberman, Hariri, Jarcho, Eisenberger, & Bookheimer, 2005; Ronquillo et al., 2007; Wheeler & Fiske, 2005), and it has also provided a basis for subsequent explorations of partisan bias in explicitly political contexts, which we review in the next section.

The broader goal of the research program initiated by Amodio et al. (2003) was to illuminate the psychological mechanisms underlying implicit racial bias, with an eye toward the incorporation of insights from neuroscience that could be applied fruitfully to the study of intergroup bias. For

**Table 1.** Summary of Brain Regions and Subregions Investigated and Major Findings in Political Neuroscience

| Structure                     | Sub-regions                     | Relevant Function(s)   | Task   | Moderator   | Suggested Political Implication   | Citation                                       |
|-------------------------------|---------------------------------|--|--|---|---|--|
| Amygdala                      |                                 | Affective significance, emotional learning                                     | Viewing preferred candidates   | Consistent across United States, Japanese participants (despite differences in social desirability of candidate traits) | People are more inclined to vote for candidates who are more emotionally salient or arousing                            | Rule et al., 2010                              |
|                               |                                 |  | Categorizing attitude-congruent politician-word pairs                                |   | Preferred political candidates elicit strong affective responses; could lead to partisan bias                           | Knutson et al., 2006                           |
| Insula                        |                                 |  | Considering political opinions with which one agrees                                 | Increased activation for those highly interested in politics  | Attitude-congruent political ideas are more arousing to those highly interested in politics                             | Gozzi et al., 2010                             |
|                               |                                 |  | Right amygdala volume associated with political conservatism (measured at rest)      |   | Greater sensitivity to threat among conservatives may be reflected in amygdala volume (see Oxley et al., 2008)          | Kanai et al., 2011 (see also Nam et al., 2013) |
|                               |                                 |  | Categorizing mixed-race individuals as Black   | Increased activation with political conservatism  | Ideological differences in neural responses to ambiguous stimuli can lead to biased race categorization                 | Krosch et al., 2013b                           |
|                               |                                 | Interoceptive awareness of bodily states (pain, disgust, empathy, homeostasis) | Passively viewing members of political out-groups                                    |   | Partisans experience feelings of distaste and general negativity toward political out-groups                            | Kaplan et al., 2007                            |
| Cingulate cortex              | Anterior cingulate cortex (ACC) | Dorsal ACC is involved in conflict monitoring and error detection              | Reading attitude-incongruent statements made by one's preferred candidate            |   | Partisans experience distress when processing incongruent information about preferred candidates                        | Westen et al., 2006                            |
|                               |                                 |  | Left insula volume associated with greater political conservatism (measured at rest) |   | Greater disgust sensitivity among conservatives may be reflected in insula volume (see Inbar et al., 2009)              | Kanai et al., 2011                             |
|                               |                                 |  | Categorizing mixed-race individuals as Black   | Increased activation with political conservatism  | Ideological differences in neural representation of objective visual "Blackness" can lead to biased race categorization | Krosch et al., 2013b                           |
|                               |                                 |  | Passively viewing members of political out-groups                                    |   | Partisans may regulate negative emotional responses to political out-groups   | Kaplan et al., 2007                            |
| Posterior cingulate/precuneus |                                 | Emotional salience processing, encoding  | Reading attitude-incongruent statements made by one's preferred candidate            |   | Partisans experience conflict when processing incongruent information about preferred candidates                        | Westen et al., 2006                            |
|                               |                                 |  | Go/No-Go task  | Increased ERN, N2 responses on No-Go trials for liberals  | Liberals are more responsive to new, unexpected, and conflicting information  | Amodio et al., 2007                            |
|                               |                                 |  | ACC volume associated with greater political liberalism (measured at rest)           |   | Greater sensitivity to conflicting information among liberals may be reflected in ACC volume (see Amodio et al., 2007)  | Kanai et al., 2011                             |
|                               |                                 |  | Rating agreement/disagreement with political statements                              | Increased activation for radical (vs. moderate) statements  | Radical statements elicit greater emotional processing  | Zamboni et al., 2009                           |



|      |                                 |   |  |  |   |   |
|------|---------------------------------|---|--|--|---|---|
| mPFC | General                         | Mentalizing and forming impressions of others   | Viewing politicians who violate stereotypical (partisan) expectations  | Increased activation for ideologically similar others  | Politicians who violate expectations may require individuation, "mentalizing"   | Cloutier et al., 2011   |
|      | vmPFC                           | Valuation, self-referential processing, mentalizing   | Making judgments about mental states of ideologically similar and dissimilar others<br>Rating agreement/disagreement with political statements   | Increased activation for individual (vs. societal) concerns  | Ideological similarity facilitates self-referential processing  | Mitchell et al., 2006   |
|      | dmPFC                           | Mentalizing about others  | Categorizing attitude-congruent politician-word pairs<br>Making judgments about mental states of ideologically similar and dissimilar others<br>Rating agreement/disagreement with political statements  | Increased activation for individual (vs. societal) concerns<br>Increased activation with valence (strength of feeling) toward politician                                     | Individualistic concerns may elicit self-referential processing   | Zamboni et al., 2009  |
|      | dIPFC                           | Cognitive control, including goal representation, response selection, and response inhibition | Passively viewing members of political out-groups<br>Watching campaign videos and evaluating political candidates<br>Rating agreement/disagreement with political statements   | Increased activation for societal (vs. individual) concerns  | Attitude-congruent political information activates stereotypic knowledge  | Knutson et al., 2006  |
|      | Ventral striatum                | Reward and value processing   | Viewing images of politicians during an unrelated visual task<br>Considering political opinions with which one agrees<br>Reading exculpatory information that justifies preferred candidate's inconsistency<br>Rating agreement/disagreement with political statements | Increased activation for preferred politicians<br>Increased activation for those highly interested in politics<br>Increased activation for moderate (vs. radical) statements | Ideological dissimilarity increases mentalizing about others (but not self-referential processing)<br>Societal/collectivistic concerns may elicit others-related processing<br>Partisans may attempt to regulate negative emotional response to political out-groups<br>Decreased partisanship following attitude-incongruent information may reflect greater focus on goal-relevant information<br>Conservative statements may trigger inhibitory impulses | Mitchell et al., 2006<br>Zamboni et al., 2009<br>Kaplan et al., 2007<br>Kato et al., 2009<br>Zamboni et al., 2009 |
|      | Temporo-parietal junction (TPJ) | "Theory of mind," perspective-taking  | Viewing politicians who violate stereotypical (partisan) expectations<br>Rating agreement/disagreement with political statements   | Increased activation for societal (vs. individual) concerns  | Preference for ingroup members reflected in neural processing, may contribute to partisan bias<br>Exposure to attitude-congruent opinions is rewarding to those interested in politics<br>Partisans may experience relief when opportunity arises to resolve inconsistency about preferred candidate<br>Reward is associated with socially accepted value of moderation   | Tusche et al., 2013<br>Gozzi et al., 2010<br>Westen et al., 2006<br>Zamboni et al., 2009                          |

Note. We describe the general function of the brain region, tasks used, moderating variables, and political implications as suggested by the original authors, along with relevant citations.

instance, Amodio and Devine (2006) observed that whereas the amygdala has a well-established role in basic affective and attentional processes, including responses to fear and threat (see LeDoux, 2000), it is not involved in the kind of high-level cognitive functions that support stereotyping (or other conceptual associations). Fear-conditioned responses can be learned very rapidly, often after a single exposure to the stimulus in a threatening context, and such associations may be difficult to extinguish (Bouton, 1994; but see Schiller et al., 2009). In addition, fear-conditioned responses are expressed primarily in autonomic responses (e.g., increased heart rate) and nonverbal behaviors (such as freezing and avoidance; see Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997; Fazio, Jackson, Dunton, & Williams, 1995).

By contrast, conceptual associations, such as stereotypes, are known to form through a slower learning process that can be more easily extinguished and more directly expressed in trait impressions, deliberative decisions, and instrumental actions (see also Smith & DeCoster, 2000). Based on neuroscientific investigations of conceptual knowledge and priming (Gabrieli, 1998; Martin, 2007), one would infer that stereotypic associations are likely to be stored in the temporal lobes and activated by regions of the dorsolateral PFC (Amodio, 2008). Consistent with the notion that prejudice (defined in terms of negative affect and evaluative bias) and stereotyping (defined in terms of beliefs and semantic associations) are distinct neurocognitive processes, Amodio and Devine (2006) demonstrated that implicit prejudice and stereotypic associations were in fact uncorrelated and that each was associated with a unique set of behavioral outcomes (see also Amodio & Hamilton, 2012; Gilbert, Swencionis, & Amodio, 2012). This line of research has been important because it integrated work from social psychology and cognitive neuroscience to illuminate basic mechanisms and suggest new hypotheses for the study of intergroup relations (see Amodio & Ratner, 2011a).

### *Using Neuroscience to Elucidate the Self-Regulation of Prejudice*

Despite pervasive evidence of implicit racial bias (e.g., see Jost et al., 2009, for a historical summary and review), some individuals—especially those who hold egalitarian worldviews—can become skilled at overriding their biases. Indeed, the human mind is fairly adept at self-regulation, and the brain is endowed with mechanisms for monitoring and correcting ongoing behavioral tendencies to keep them in check (Miller & Cohen, 2001). Until recently, however, work on racial bias has lacked a process-oriented theory to explain how people detect the need for self-regulation in the first place and how different forms of control, such as the inhibition of a given response or the selection of an alternative response, are implemented (see Amodio & Ratner, 2011b). The question of whether (and, if so, how) people are capable of controlling prejudicial impulses has fairly obvious implications for racial politics in general (e.g., see Sears et al., 2000).

Early models of the control of racial bias assumed that successful self-control depended upon situational and motivational affordances (i.e., whether one has the opportunity to correct an initial response; Devine, 1989; Fazio, 1990). However, researchers frequently observed that egalitarians (with similar racial attitudes and in identical situations) varied substantially in their abilities to respond without implicit bias (e.g., Devine, Plant, Amodio, & Harmon-Jones, & Vance, 2002), suggesting that the extant models of control were insufficient. Building on theories of cognitive control in the neuroscience literature, Amodio et al. (2004) proposed that the regulation of intergroup bias involves at least two mechanisms: (1) the detection of an undesirable response tendency (i.e., a “bias”), which should be associated with activity of the dorsal anterior cingulate cortex (ACC), and (2) the implementation of a more desirable, overriding (i.e., egalitarian) response, which should be associated with regions of the lateral prefrontal cortex (PFC; see Figure 1 and Table 1). Thus, despite harboring a strong personal commitment to responding without prejudice, some egalitarians might have difficulty detecting the need for control in the first place. This distinction between detection and implementation is critical when it comes to reducing prejudice. Whereas most interventions seek to



foster a commitment to social justice, this work suggests that, for some people, what is needed is a personal strategy to help with detection and control.

Using event-related potential (ERP) measures, which track changes in brain activity on the order of milliseconds, Amodio and colleagues observed that the dACC was involved in the detection of unwanted stereotype activation and that this detection process operated independently of the implementation of control (see also Amodio, Kubota, Harmon-Jones, & Devine, 2006; Bartholow, Dickter, & Sestir, 2006). It was demonstrated subsequently that individual differences in conflict sensitivity—as indicated by ACC activity in response to implicit stereotype activation—could indeed help to explain why some egalitarians were more skilled at controlling their biases than others (Amodio, Devine, & Harmon-Jones, 2008).

Amodio, Devine, and Harmon-Jones (2007) observed that the lateral PFC appears to play a useful role in the implementation of egalitarian responses. More specifically, participants who sought to regulate prejudice exhibited increased activity in the left lateral PFC, and this pattern of activity predicted behavioral intentions designed to reduce prejudice. Amodio (2010b) found that the relation between PFC activity and behavioral control of implicit bias was mediated by changes in rapid attention to racial cues. Several other studies using fMRI monitored activity in the ACC and PFC as participants viewed images of Black and White faces. Although the tasks used in these studies were not designed to explicitly assess the control of racial bias, the observed patterns of brain activity suggest that participants may have spontaneously engaged in processes of self-regulation (e.g., Cunningham et al., 2004; Lieberman et al., 2005; Richeson et al., 2003; Wheeler & Fiske, 2005). Taken as a whole, this body of research has helped to unpack specific mechanisms of self-control in the context of intergroup relations, highlighting the various points at which control may fail in the sequence of mental operations. In doing so, this work provides a scientific basis for developing targeted interventions to reduce prejudice (Mendoza, Gollwitzer, & Amodio, 2010; see also Beer et al., 2008; Gonsalkorale, Sherman, Allen, Klauer, & Amodio, 2011; Monteith, Ashburn-Nardo, Voils, & Czopp, 2002).

### *Categorization and Perception of Race and Sex*

Although the social psychological literature on person perception suggests that attributes such as race and sex are categorized rapidly and automatically (Bodenhausen & Macrae, 1998; Brewer, 1988; Fiske & Neuberg, 1990), the specific timing and sequence of social categorization processes has been difficult to discern on the basis of behavioral measures alone. Several research teams have focused on ERPs to investigate the timing in which individuals are perceived, categorized, and stereotyped (Bartholow & Amodio, 2009; Bartholow, Fabiani, Gratton, & Bettencourt, 2001; Ito & Cacioppo, 2000; Quadflieg & Macrae, 2011). For instance, studies by Ito and Urland (2003) indicated that the categorization process involves multiple processing stages, and yet the brain registers a given target person's race in as little as 120 milliseconds and his or her sex within approximately 180 milliseconds. Other work revealed that stereotyping on the basis of race (Bartholow et al., 2003) and sex (Bartholow et al., 2001) occurs within 450 milliseconds—after the initial categorization, but before extensive conscious deliberation.

Recently, researchers have started to use neuroscientific methods to examine visual perceptions of race on the basis of physical markers of group membership (e.g., Amodio, 2010b; Brosch, Bar-David, & Phelps, 2013; Caldara et al., 2003; Gilbert, Swencionis, & Amodio, 2012; Kaul, Ratner, & Van Bavel, 2013; Ofan, Rubin, & Amodio, 2011; Ratner, Kaul, & Van Bavel, 2012). Humans are expert face perceivers, and a large body of work has identified specific brain regions that appear to be dedicated to face processing, such as the fusiform gyrus (Kanwisher, McDermott, & Chun, 1997; cf. Haxby, Hoffman, & Gobbini, 2000). In an early fMRI study, Golby, Gabrieli, Chiao, and Eberhardt (2001) observed greater activity in the fusiform gyrus in response to own-race (vs.

other-race) faces, and the magnitude of this difference predicted subsequent advantages in terms of recognition memory for own-race (vs. other-race) faces (see also Malpass & Kravitz, 1969). Representations of race in the perceptual system are sensitive to visual information, such as skin tone and physiognomic features (Brosch et al., 2013; Gilbert et al., 2012; Ratner et al., 2013), as well as the goals and expectations of the perceiver (Amodio, 2011b; Gilbert et al., 2012; Kaul et al., 2013; Ofan et al., 2011, 2013; Ratner & Amodio, 2013). In some ways, research on visual perception represents the newest frontier in the study of intergroup relations, and it provides yet another example of how neuroscience can offer unique insights when it comes to addressing long-standing questions in social and political psychology.

### **The Existence of Partisan Bias and Motivated Political Cognition**

A significant challenge to rational choice models of political decision making, which assume that voters process politically relevant information more or less accurately, and, by extension, normative theories of democratic functioning is posed by strong behavioral evidence of motivated reasoning and partisan bias in the political domain (see Lavine, Jost, & Lodge, in press). This evidence indicates that political information processing is prone to a host of self-serving, group-serving, and system-serving biases (Jost, Hennes, & Lavine, 2013), such as tendencies to defend and bolster preexisting beliefs and opinions in the face of contradictory evidence (Taber & Lodge, 2006). Motivational factors, including partisan and ideological goals, often guide and distort processes of reasoning and judgment (e.g., Kunda, 1990). The psychophysiological basis of motivated political reasoning was proposed a decade ago by Morris, Squires, Taber, and Lodge (2003), but only very recently have researchers begun to apply neuroscientific methods to probe the phenomenon in detail.

#### *Partisanship and Ingroup Favoritism*

Research suggests that attitudes toward social policies can be strongly influenced by partisan cues, independent of the policy's content and, in some cases at least, participants' ideological beliefs (e.g., Cohen, 2003). This finding is consistent with over 40 years of research on the phenomenon of ingroup favoritism, defined as the tendency to value members of one's own group more highly than members of other social groups (Tajfel, Billig, Bundy, & Flament, 1971). More recently, studies in social neuroscience have found that merely assigning individuals to temporary, ad hoc (i.e., "minimal") social groups can influence basic cognitive and perceptual processes. Using ERP methods, Ratner and Amodio (2013) demonstrated that even arbitrary group distinctions led participants to process ingroup faces differently than out-group faces—and in just 170 milliseconds.

Van Bavel, Packer, and Cunningham (2008, 2011) randomly assigned participants to mixed-race experimental groups and found that seemingly automatic perceptual responses were sensitive to these assignments but not to racial distinctions. Specifically, participants exhibited heightened activity in the amygdala and the fusiform gyri in response to ingroup (vs. out-group) members, regardless of their race (see Van Bavel & Cunningham, 2011 for a review). This pattern of ingroup bias emerged even in the absence of common visual cues distinguishing group membership (such as hair or shirt color), as well as the absence of preexisting stereotypes or a history of intergroup conflict. Other research suggests that assignment to a mixed-race experimental group can reduce subtle forms of racial bias (Van Bavel & Cunningham, 2009, 2012). Taken in conjunction, this work indicates that even fairly minimal group-based affiliations can exert considerable influence over social cognition and behavior.

In political domains, ingroup favoritism may be intensified by a history of conflict and competition for limited resources (i.e., votes), differences in values and ideology, and the stereotypical exaggeration of actual differences. As a result, it is hardly surprising that partisan affiliations

influence how individuals evaluate political candidates as well as policy proposals. In one of the first studies of neural correlates of political preferences, participants were instructed to classify faces of Democratic and Republican politicians that were paired with either positive or negative stimulus words (in the context of an Implicit Association Test; IAT) while their brains were scanned (Knutson et al., 2006). Results revealed that on attitude-congruent trials (when pleasant words were paired with political ingroup members or unpleasant words were paired with political out-group members), a network of frontal cortical structures including the ventromedial PFC—a region that is involved in the processing of subjective preferences—was activated. Furthermore, participants' implicit attitudes toward the parties (IAT scores) were correlated with amygdala activation during the presentation of attitude-congruent trials. Because the amygdala is involved in emotional reactivity and learning (e.g., Gallagher & Chiba, 1996), Knutson and colleagues (2006) interpreted this pattern of activation as indicative of partisan bias at the neural level. However, it should be noted that these results are somewhat difficult to interpret, insofar as they could reflect neurocognitive processes associated with the basic categorization task rather than political attitudes per se. Nevertheless, this study was important because it took the first step in exploring the neural correlates of partisan political preferences.

#### *Differential Processing of Preferred and Nonpreferred Candidates*

The effects of partisanship have also been explored in the context of individuals' responses to overtly political content. In two parallel studies, Democrats and Republicans were asked to make judgments about Democratic (John Kerry) and Republican (George W. Bush) presidential candidates during the run-up to the 2004 U.S. election (Kaplan, Freedman, & Iacoboni, 2007; Westen et al., 2006). In the first of these, participants were presented with a sequence of neutral and attitude-inconsistent information (i.e., evidence that their preferred candidates had made inconsistent statements) and, finally, exculpatory information (Westen et al., 2006). When partisans were confronted with attitude-incongruent information, they exhibited increased activity in the lateral and medial orbital PFC, ACC, insula, and posterior cingulate cortex (see Figure 1 and Table 1). Given that these regions are involved in the processing of pain, negative affect, error detection, and emotional appraisals (e.g., Baliki, Geha, Apkarian, 2009; Botvinick, Braver, Barch, Carter, & Cohen, 2001; Vogt, 2005), the authors suggested that partisans experienced distress when they were faced with negative information about preferred candidates. However, when participants were invited to reflect on the incongruent information, they exhibited increased activation of the ventral striatum—a region frequently implicated in reward and value processing (Galvan et al., 2005). The study by Westen and colleagues is therefore intriguing because it suggests that exposure to attitude-incongruent information is distressing, but the opportunity to resolve inconsistencies through a process of explanation or justification may be physiologically as well as psychologically rewarding.

In a similar study, Kaplan and colleagues (2007) instructed Democrats and Republicans to view pictures of the major presidential candidates (Kerry, Bush, and Green Party candidate Ralph Nader) during a neuroimaging session. When viewing political out-group members, both Democrats and Republicans exhibited increased activity in several brain regions, including the insula, ACC, and multiple regions of the dorsolateral PFC. These patterns of activation were widely distributed, but the authors speculated—on the basis of prior research linking insula activity to the experience of disgust (Wicker et al., 2003)—that participants may have experienced (or even amplified) negative emotions when viewing candidates from opposing political parties. However, because participants were merely instructed to view pictures of candidates, it is unclear whether they experienced specific emotions or engaged in processes of emotional self-regulation. In the absence of a task that requires executive control, inferring the operation of controlled processes remains highly speculative (Aron

et al., 2007; Poldrack, 2008). At the same time, these results are consistent with the broader notion that partisan affiliations reflexively bias neurocognitive responses to political candidates.

Some research suggests that partisan biases may operate even in the absence of explicit attention to political content (see Tusche, Kahnt, Wisniewski, & Haynes, 2013). For instance, German participants who were flashed images of preferred (vs. nonpreferred) politicians exhibited greater activity in the insula, cingulate cortex, and ventral striatum (see Figure 1). These effects were observed despite the fact that their attention was drawn to an unrelated visual fixation task, suggesting that partisan biases may stimulate implicit evaluations of political candidates in the absence of a task requiring political judgment.

Of course, citizens who follow elections closely are subjected to a barrage of political messages and persuasive communications, so it is important to investigate attitude change processes, especially when it comes to partisans. During a scanning session, Kato and colleagues (2009) asked participants to evaluate the two major presidential candidates of 1992 (Democrat Bill Clinton and Republican George H.W. Bush) before and after watching campaign videos from that year. Participants who showed stronger dlPFC activity while watching negative videos about their preferred candidate became less positive toward him, whereas those who exhibited stronger mPFC activity while watching negative videos about their preferred candidate became more positive. Although prominent social psychological models of persuasion seek to explain attitude change in terms of a unitary process of “elaboration” (e.g., Petty & Cacioppo, 1986), this pattern of activation suggests that slightly different neural systems may underlie positive and negative forms of attitude change towards political candidates. Research of this kind may ultimately help to shed light on the questions of when, why, and how people are likely to change their attitudes when they are confronted with political advertisements and other attempts at persuasion (e.g., see McGuire, 1985).

Other research suggests that exposure to attitude-congruent political information is inherently rewarding—at least for those who are interested in and engaged in politics. Gozzi, Zamboni, Krueger, and Grafman (2010) drew this conclusion after comparing the neural activity of participants who were high (vs. low) in terms of self-reported interest in politics, quantity of political media consumption, and frequency of political conversations while participants rendered judgments of agreement or disagreement with a series of political statements. Individuals who were more (vs. less) interested in politics exhibited stronger activation of the amygdala and ventral striatum when judging opinions with which they agreed. In light of behavioral evidence indicating that participants with greater political interest rate attitude-congruent statements as more positive and more emotionally intense—and the fact that the amygdala is linked to emotional salience (Anderson & Phelps, 2001; Cunningham et al., 2008; Whalen, 1998) and the ventral striatum is linked to reward processing (Galvan et al., 2005; O’Doherty, 2004)—there is reason to assume that political junkies find exposure to ideas with which they agree to be arousing and intrinsically satisfying. If so, there could be a powerful physiological feedback loop that contributes to political polarization by incentivizing selective exposure to information that validates preexisting opinions (e.g., Sears & Freedman, 1967). Our own work—and that of others—suggests that there may be left-right ideological differences in the extent to which individuals are willing to expose themselves to politically incongruent information (Garrett, 2009; Iyengar, Hahn, Krosnick, & Walker, 2008; Nam, Jost, & Van Bavel, 2013). Future research in political neuroscience would do well to follow up on this possibility, especially given the litany of psychological and neural correlates of political orientation that we review later in the chapter (see also Hibbing et al., in press; Jost & Amodio, 2012).

At the same time, partisans from quite different cultures may have more in common than one might assume when it comes to evaluating political candidates. Although some work suggests that Americans tend to prioritize power (or dominance) whereas Japanese tend to prioritize warmth when evaluating and selecting political candidates, both American and Japanese participants were found to exhibit stronger bilateral amygdala activation when they viewed faces of political candidates for

whom they would (vs. would not) vote (Rule et al., 2010). Because the amygdala plays a prominent role in responding to rewards, threats, and other emotionally salient events (e.g., Cunningham, Van Bavel, & Johnsen, 2008; Holland & Gallagher, 1999; Whalen, 1998), the authors concluded that there may be a universal association between emotional arousal and voting intentions. This work highlights one potential advantage of neuroimaging research: that it can help to illuminate ways in which seemingly disparate behavioral outcomes can mask deeper, underlying similarities in the processing of information and opinion.

### *Simulating the Mental States of Ingroup Versus Out-Group Members*

Another advantage of neuroimaging techniques is that they can help to disentangle the multiplicity of neural systems involved in complex cognitive operations. For instance, work by Mitchell, Macrae, and Banaji (2006) suggests that political partisans process the mental states of fellow ideologues differently than those who hold divergent opinions. During neuroimaging, Harvard undergraduates were asked to make sequential judgments about the mental states of a liberal target, a conservative target, and themselves. When students were instructed to think about those who were ideologically similar to themselves, they exhibited increased activation of the vmPFC, a region that is sometimes associated with self-referential processing (e.g., Macrae, Moran, Heatherton, Banfield, & Kelley, 2004). By contrast, when these students were asked to make judgments about those who were ideologically dissimilar, they exhibited increased activation of the dmPFC, a region that is associated with thinking about the mental states of others but seems to be unrelated to self-referential processing (Mitchell, Heatherton, & Macrae, 2002).<sup>1</sup> Mitchell and colleagues proposed that the “simulation” of mental states is facilitated for fellow ideologues (and inhibited for ideological out-group members)—a notion that has fairly obvious but nonetheless profound implications for perspective taking, negotiation, and the resolution of political conflicts (see Krochik & Jost, 2011). Other work suggests not only that individuals show more (verbal and nonverbal) signs of empathy when it comes to ingroup (vs. out-group) members (Cikara, Bruneau, & Saxe, 2011), but that the magnitude of the “empathy gap” (measured in terms of neurological responses) predicts willingness to mistreat out-group members (Hein, Silani, Preuschoff, Batson, & Singer, 2010). It is hardly a stretch to suggest that partisan gridlock may stem, at least in part, from a lack of perspective taking and empathy for members of a competing political party.

Social psychologists have long assumed that impressions of other people may be more influenced by stereotypes and social categories than by personalized, individuating information (e.g., Macrae & Bodenhausen, 2000). However, stereotypic expectations are often violated during the period of impression formation (Hamilton, Driscoll, & Worth, 1989; Hastie & Kumar, 1979; Macrae, Bodenhausen, Schloerscheidt, & Milne, 1999; Sherman, Lee, Bessenoff, & Frost, 1998)—such as when a politician endorses policy positions that deviate from that of his or her party. Although neuroimaging studies have largely focused on the neural substrates associated with categorical, stereotype-based responses (Gilbert et al., 2012; Mitchell, Ames, Jenkins, & Banaji, 2009; Quadflieg et al., 2009; Wheeler & Fiske, 2005), one study has examined neural responses to expectancy violations in a political context (Cloutier, Gabrieli, O’Young, & Ambady, 2011). Students at MIT were presented with photographs of 80 unfamiliar Democratic and Republican politicians who were paired

<sup>1</sup> Mitchell et al. (2006) did not statistically compare liberals and conservatives, but close inspection of their figures (p. 657) suggests that the decrease in ventral mPFC activation in response to out-group (i.e., “liberal other”) targets for participants who were “dissimilar from liberal” (i.e., more conservative) might have been larger than the corresponding decrease for liberal participants who responded to conservative targets (Figure 2A). Similarly, conservatives seemed to show greater activation of dorsal mPFC in response to liberals than liberals showed in response to conservatives (Figure 2B). Future research would do well to investigate potential ideological asymmetries with respect to neural markers of empathy and perspective taking, in light of other evidence reviewed in this chapter.



with views that were either typical or atypical of their party (e.g., “wants a smaller government” or “wants liberal supreme court judges”) and asked to form impressions of the targets. As hypothesized, brain regions associated with mentalizing—including the medial prefrontal cortex and temporoparietal junction (Adolphs, 2009; Amodio & Frith, 2006; Mitchell et al., 2006; Saxe & Wexler, 2005; Spreng, Mar, & Kim, 2009)—were more active when participants viewed nonstereotypical targets, such as a Democrat who preferred smaller government or a Republican who supported liberal supreme court judges. The authors speculated that exposure to expectancy-violating politicians caused participants to individuate them and, in so doing, to recruit brain regions that are required for mentalizing (cf. Brewer, 1988; Fiske & Neuberg, 1990; Macrae et al., 1999). The implication is that people may think more deeply about the mental states of politicians who deviate from their parties’ official platforms. More speculatively, the enforcement of “party loyalty” and ingroup consensus could serve to reduce empathy and contribute to a lack of respect for individual politicians.

### The Nature of Left-Right Differences in Political Orientation

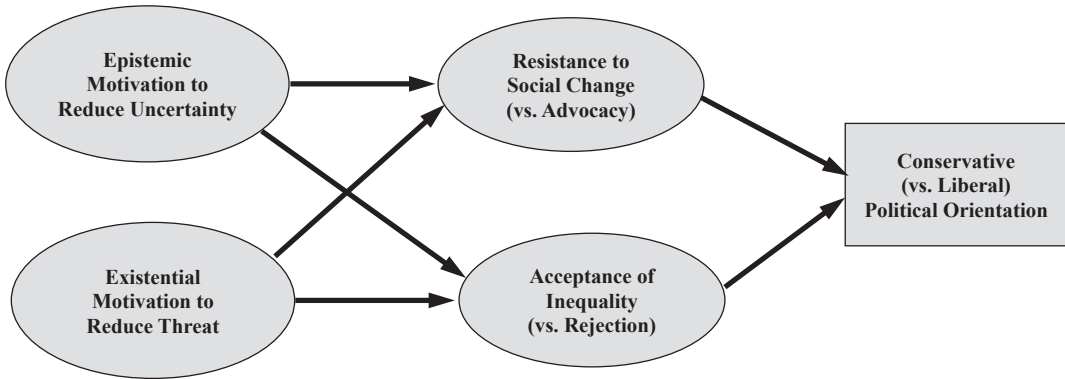
Although the political meanings of the terms “left” and “right” are most clearly vestiges of the French Revolution, several authors have suggested that the substantive distinction is in fact much older than 1789 (e.g., see Noël & Thérien, 2008). Indeed, their ideological connotations seem to be linked to pervasive cultural assumptions in Indo-European societies concerning handedness and dominance (McManus, 2002). More than a century ago, for instance, Hertz (1909) wrote that “the right hand is the symbol and model of all aristocracy, the left hand of all common people” (p. 89). LaPonce (1981) similarly observed that throughout Medieval Europe the right was the “side of God” and was “universally associated with the notion of privilege, dominance, and sacredness” (p. 10). Philosophical differences between the left and right concerning views of human nature, power, majority-minority relations, and systems of distributive justice are frequently traced to debates originating in ancient Greece (e.g., see Noël & Thérien, 2008; Raphael, 2001; Tarnopolsky, 2010). In this section of the chapter, we suggest that philosophical differences such as these may be linked to underlying variability in brain structure and function. Or, as Taber and Young (2013, p. 549) put it, “what we believe” is related to “how we think.”

#### *Resistance to Change, Acceptance of Inequality, and System Justification*

There are many different but related ways of thinking about the core values that divide the political right from the left (or, in the United States and elsewhere, conservatism from liberalism), but Jost and his colleagues (Glaser, Kruglanski, & Sulloway, 2003; Jost, Nosek, & Gosling, 2008; Jost et al., 2009) have noted that two major dimensions are most commonly emphasized: (1) resisting versus advocating social change (that is, maintaining vs. challenging tradition) and (2) accepting versus rejecting inequality (that is, challenging vs. maintaining hierarchy). Thus, Inglehart (1989)—like many others (e.g., Erikson, Luttbeg, & Tedin, 1988; Fuchs & Klingemann, 1990; Lipset, Lazarsfeld, Barton, & Linz, 1954/1962; McClosky & Zaller, 1984)—boils it down to “whether one supports or opposes social change in an egalitarian direction” (p. 293). Jost, Federico, and Napier (2013) have proposed that *system justification*, defined as the psychological tendency to defend, bolster, and justify aspects of the status quo, is:

the motivational “glue” that holds the two dimensions of left-right ideology together. To vindicate and uphold traditional institutions and arrangements, conservatives are bound to defend extant inequalities as just and necessary. Conversely, to bring about a more equal state of affairs, progressives are obliged to criticize existing institutions and practices. (p. 236)





**Figure 2.** Schematic illustration of the theory of political ideology as motivated social cognition (Adapted from Jost, 2009).

Ideological differences with respect to the two core values are manifested even at an implicit level of awareness. Studies employing the IAT—a measure of implicit evaluative associations—reveals that conservatives exhibit preferences for stability, tradition, duty, and command, whereas liberals exhibit preferences for opposite values, such as flexibility, progress, compromise, diversity, and feminism (Jost, Nosek, & Gosling, 2008; Smith et al., 2011b).

Research on the underlying personality characteristics of liberals (or leftists) and conservatives (or rightists) began in the aftermath of the Second World War (e.g., Adorno, Frenkel-Brunswik, Levinson, & Sanford, 1950; Allport, 1954; McClosky 1958). Drawing on these early contributions—as well as subsequent work by Rokeach (1960), Tomkins (1963), Wilson (1973), Tetlock (1983), and Sidanius (1985)—Jost et al. (2003) theorized that social and political attitudes concerning tradition (vs. social change) and inequality are linked to underlying epistemic and existential motives having to do with the management of uncertainty and threat (see Figure 2). They also reported the results of a meta-analytic review of 88 studies conducted in 12 countries between 1958 and 2002, which established that situational and dispositional variability in psychological orientations toward uncertainty and threatening stimuli were related to left-right political orientation. Specifically, death anxiety, fear of threat and loss, system threat, mental rigidity, intolerance of ambiguity, and personal needs for order, structure, and closure were all positively associated with conservatism (or negatively associated with liberalism). By contrast, openness to new experiences, cognitive complexity, tolerance of uncertainty, and self-esteem were all positively associated with liberalism (or negatively associated with conservatism).

There is now abundant evidence from research sites around the world using a wide range of methodological techniques leading to the conclusion that there are indeed ideological asymmetries in cognitive and motivational functioning. Specifically, a decade of research has replicated and extended the results of Jost et al.’s (2003) analysis by demonstrating each of the following:

- 1) Political conservatism and right-wing orientation are associated with higher scores on measures of general, economic, and political system justification (Jost et al., 2008; see also Chambers, Schlenker, & Collisson, 2013; Cichocka & Jost, 2013; Hennes, Nam, Stern, & Jost, 2012; Jost, West, & Gosling, 2009; Lammers & Proulx, 2013; Pacilli, Taurino, Jost, & Van der Toorn, 2011);
- 2) Resistance to change and acceptance of inequality are correlated with one another, and they are generally (but not always) associated with system justification, political conservatism, and right-wing orientation (Aspelund, Lindeman, & Verkasalo, 2013; Jost et al., 2007; Kandler, Bleidorn, & Riemann, 2012; Lammers & Proulx, 2013; Piurko, Schwartz, & Davidov, 2011; Vecchione, Caprara, Dentale, & Schwartz, 2013);

- 3) Personal needs for order, structure, and cognitive closure are positively associated with resistance to change, acceptance of inequality, system justification, political conservatism, and right-wing orientation (Chirumbolo, Areni, & Sensales, 2004; Critcher, Huber, Ho, & Koleva, 2009; Dollinger, 2007; Federico, Ergun, & Hunt, 2013; Federico & Goren, 2009; Golec de Zavala & Van Bergh, 2007; Hennes et al., 2012; Jost et al., 2007; Keller, 2005; Kimmelmeier, 2007; Nam et al., 2013; Sargent, 2004; Shook & Fazio, 2009; van Hiel, Pandelaere, & Duriez, 2004);
- 4) Situational activation of epistemic needs to reduce uncertainty or to attain a sense of control or closure tends to increase the appeal of system justification, political conservatism, and right-wing orientation (Eidelman, Crandall, Goodman, & Blanchard, 2012; Kay, Gaucher, Napier, Callan, & Laurin, 2008; Kay et al., 2009; Lammers & Proulx, 2013; Rock & Janoff-Bulman, 2010; Rutjens & Loseman, 2010; Thorisdottir & Jost, 2011);
- 5) Personal concern for and sensitivity to dangerous and threatening stimuli are positively associated with resistance to change, acceptance of inequality, and political conservatism (Carraro, Castelli, & Macchiella, 2011; Jost et al., 2007; Matthews, Levin, & Sidanius, 2009; Onraet, Van Hiel, Dhont, & Pattyn, 2013; Oxley et al., 2008; van Leeuwen & Park, 2009; Vigil, 2010; Weber & Federico, 2007);
- 6) Situational activation of existential needs to manage fear and anxiety often increases the appeal of system justification, political conservatism, and right-wing orientation (Bonanno & Jost, 2006; Burke, Kosloff, & Landau, 2013; Nail & McGregor, 2009; Nail, McGregor, Drinkwater, Steele, & Thompson, 2009; Thorisdottir & Jost, 2011; Ullrich & Cohrs, 2007);
- 7) In terms of “Big Five” personality characteristics, openness to new experiences is positively associated with liberal, left-wing orientation, whereas conscientiousness (especially the need for order facet) is positively associated with conservative, right-wing orientation (Carney, Jost, Gosling, & Potter, 2008; Gerber, Huber, Doherty, & Dowling, 2010; Hirsh, DeYoung, Xu, & Peterson, 2010; Jost et al., 2009; Mondak, 2010; Rentfrow, Jost, Gosling, & Potter, 2009);
- 8) Childhood measures of intolerance of ambiguity, uncertainty, and complexity as well as sensitivity to fear, threat, and danger predict conservative orientation later in life (Block & Block, 2006; Fraley, Griffin, Belsky, & Roisman, 2012); and
- 9) Political conservatives report being happier and more satisfied than liberals, and this effect is partially mediated by system justification and acceptance of inequality (Choma, Busseri, & Sadava, 2009; Cichocka & Jost, 2013; Napier & Jost, 2008; Schlenker, Chambers, & Le, 2012).

Increasingly, researchers are turning to physiological methods, especially neuroscientific methods, to examine the cognitive and motivational bases of ideology. Such work is especially valuable because it helps to illuminate the origins, manifestations, and consequences of ideological preferences as well as the specific processes by which ideology affects judgment and behavior (for reviews, see Hibbing et al., in press; Jost & Amodio, 2012).

To the extent that some neurocognitive mechanisms are automatic and therefore relatively impervious to conscious monitoring and control, research in political neuroscience has the advantage of circumventing limitations associated with traditional methods of self-report, including response biases associated with self-presentational and social desirability concerns (cf. van Hiel, Onraet & De Pauw, 2010). In some cases, there may be ideological differences at the level of cognitive or affective processing even in the absence of differences in behavioral outcomes (e.g., Schreiber et al., 2013). Our review of the literature is highly consistent with that of Taber and Young (2013), who concluded that: “It is now clear that liberals and conservatives differ in terms of uncontrolled *physiological* responses to stimuli, brain function, and even static brain anatomy” (p. 541). Political neuroscience, in other words, has given researchers a new and unprecedented ability to observe underlying processes that are associated with ideological outcomes.

*Differences in Brain Activity as a Function of Political Orientation*

Drawing on Jost et al.’s (2003) model of political ideology as motivated social cognition, Amodio and colleagues (2007) reasoned that liberals and conservatives might differ in conflict monitoring, a neurocognitive process that functions to detect discrepancies between inconsistent response tendencies (Botvinick et al., 2001). The study was somewhat unique in that the primary research goal was not to identify neural substrates per se, but to leverage scientific understanding about known patterns of neural activity to inform and test a novel hypothesis about differences in conflict monitoring as a function of political orientation. In the context of a “Go/No-Go task,” participants were instructed to respond as quickly as possible to a frequently presented (“Go”) stimulus, so that these responses became habitual. On a small proportion of trials, however, a “No-Go” stimulus appeared; for these trials, participants were instructed to withhold their habitual responses. Conflict detection—the process of detecting a conflict between one’s intention and a prepotent response tendency, which is evoked by laboratory tasks such as the Go/No-Go, Stroop, and Eriksen flankers tasks—is associated with brain activity in the ACC (e.g., Carter et al., 1998; Gehring, Goss, Coles, Meyer, & Donchin, 1993). Research has also linked ACC activity to the detection of automatic racial biases (Amodio et al., 2004) and individual differences in the motivation to respond without prejudice (Amodio & Devine, 2006; Amodio et al., 2008).

Political orientation was indeed correlated with performance on the Go/No-Go task as well as concurrent patterns of brain activity (measured in terms of N2 and error-related negativity [ERN] amplitudes) in samples of NYU and UCLA undergraduates (see Table 2). More specifically, self-reported liberalism, which was strongly correlated with voting for John Kerry over George W. Bush in the 2004 election, was associated with behavioral accuracy on No-Go trials (i.e., successful attempts to withhold prepotent responses). In addition, liberals exhibited larger ERN amplitudes, indicating greater brain activity in the ACC on No-Go trials, even after adjusting for behavioral accuracy. These results support the hypothesis that political orientation is partially rooted in basic neurocognitive mechanisms—such as those involved in conflict monitoring—that are implicated in the processing of new, unexpected, and potentially contradictory pieces of information (see also Shook & Fazio, 2009). Studies such as this may help to explain how and why liberals and conservatives differ when it comes to psychological needs for order, structure, and closure as well as epistemic orientations concerning ambiguity, uncertainty, and complexity (Jost et al., 2003; Jost et al., 2007; Jost et al., 2009).

**Table 2.** Correlations Between Political Orientation and Measures of Voting Behavior, Task Performance, and ACC Activation in the Context of a Go/No-Go Experiment

|  | Correlation with Political Orientation<br>(Liberalism–Conservatism) |
|--|---|
| Self-reported voting behavior in 2004 (Bush vs. Kerry) | .79***  |
| Accuracy on No-Go trials                               | -.30*   |
| No-Go N2 amplitudes                                    | -.41**  |
| ERN amplitudes   | -.59***   |
| ERN amplitudes adjusting for accuracy                  | -.53***   |

*Note.* This table summarizes the results of an experiment reported by Amodio et al. (2007). Political orientation was measured in terms of ideological self-placement on a scale ranging from -5 (“extremely liberal”) to 5 (“extremely conservative”), so higher scores indicate greater conservatism. For this table, the ERN and N2 amplitudes, both of which are negative-going waveforms, were reverse-scored, so that more positive values indicate greater ACC activity. All correlations are based on a sample size of 41 college students from University of California, Los Angeles and New York University, except for the correlation with voting behavior, which is based only on those 21 participants who reported voting in the 2004 presidential election.

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

Weissflog, Choma, Dywan, van Noordt, and Segalowitz (2013) replicated the results of the Amodio et al. (2007) study in a sample of undergraduates in Canada. They observed that self-reported liberalism, attitudinal rejection of inequality, and low scores on right-wing authoritarianism were all associated with greater ACC activity on No-Go trials, as measured in terms of N2 (and, less consistently, ERN) amplitudes.<sup>2</sup> This general line of work demonstrates that the application of theory and methods from neuroscience can inspire political psychologists to make discoveries that spawn new and additional hypotheses—in this case, hypotheses concerning the relationship between political ideology and self-regulation—that were neither planned nor envisioned on the basis of behavioral research alone.

To further probe liberal-conservative differences in attention and conflict monitoring, McLean et al. (2013) administered the “flanker task,” which requires participants to attend to a series of target stimuli (in this case, faces) in the center of a display and to ignore potentially distracting stimuli (other faces, which may be either congruent or incongruent with the target in terms of emotional expression). Consistent with the notion that conservatives are more vigilant than liberals when it comes to potential threats in the environment (e.g., Hibbing et al., in press; Jost et al., 2003; Oxley et al., 2008; Vigil, 2010), this study revealed that conservatives displayed enhanced sensitivity to angry (but not happy) target faces, as revealed by reaction time indicators of attentional narrowing.

To better understand the genetic and social transmission of political attitudes, Dennis, Jost, Amodio, O’Toole, and Medina (2013) investigated the relationship between parental political orientation and young children’s neural sensitivity to cognitive conflict (measured in terms of the N2 component). The EEG activity of children between the ages of five and seven was recorded while they completed an age-appropriate flanker task. Consistent with the results of McLean et al. (2013), effects of political orientation were observed only in the context of being presented with angry (i.e., threatening) faces, so that conflict-related N2 amplitudes on these trials were larger among children of liberals (and moderates) than conservatives. This pattern of results conceptually replicates, in children, an effect of political orientation on neurocognitive functioning that was documented in a study of adults by Amodio et al. (2007) and provides evidence concerning the cross-generational transmission of political orientation in a manner that is consistent with Jost et al.’s (2003) theoretical model of ideology as motivated social cognition.

### *Political Orientation and Hypodescent in Racial Classification*

Following the repeal of antimiscegenation laws and the gradual normalizing of Black-White relationships in the long and painful wake of slavery, the United States has become a truly multiracial society. At the same time, mixed-race individuals are commonly described in monoracial terms, with Black/White biracial targets often classified as “Black” rather than “White.” The tendency to categorize multiracial individuals according to their most socially subordinate group membership reflects the principle of hypodescent, which is associated with the notorious “one drop rule” in U.S. history. Social psychological research reveals that the principle of hypodescent characterizes racial categorization even today (Halberstadt, Sherman, & Sherman, 2011; Ho, Sidanius, Levin, & Banaji, 2011; Peery & Bodenhausen, 2008).

To the extent that political conservatives are more supportive of the traditional social order and more accepting of inequality than are liberals, Krosch, Berntsen, Amodio, Jost, and Van Bavel (2013a) hypothesized that political orientation would moderate racial categorization under circumstances of ambiguity. In three studies, it was observed that conservatives exhibited stronger reliance

<sup>2</sup> Inzlicht, McGregor, Hirsh, and Nash (2009) observed that religiosity was negatively associated with ERN amplitudes in response to errors made during a Stroop (color naming) task. Given the relatively strong correlation between religiosity and conservatism (e.g., Olson & Green, 2006), this result is also consistent with the notion that ideological differences in epistemic motivation may be linked to neurocognitive responses to conflict.

on the principle of hypodescent, using a more lenient threshold than liberals in categorizing mixed race faces as Black. Consistent with the notion that system justification motivation helps to explain this phenomenon, the relationship between political orientation and racial categorization was: (1) statistically mediated by individual differences in opposition to equality and (2) stronger when U.S. participants believed that they were classifying “American” rather than “Canadian” faces.

A follow-up study was conducted to assess whether ideological differences in racial categorization are driven by differences in the subjective categorization of mixed-race faces or more basic differences in the representation of objective visual features (i.e., “Blackness”; Krosch, Jost, & Van Bavel, 2013b). Forty-five White participants completed a self-report questionnaire assessing political orientation (i.e., liberalism-conservatism). At a later date, they were invited to complete a race-categorization task during neuroimaging. Consistent with previous research (Ronquillo et al., 2007), brain activity in the amygdala and anterior insula was positively correlated with the objective Blackness of the faces. Importantly, individual differences in political orientation moderated the relationships between objective face “Blackness” and insula activity, so that conservatism was associated with stronger insula activity in response to morphed faces reflecting a higher proportion of Black (vs. White) ancestry. This research illustrates one way in which neuroimaging techniques can be used to tease apart separate psychological mechanisms that may be difficult to disentangle at the level of judgment or behavior. In this case, it may also help to explain how, why, and when multiracial individuals are likely to be categorized as members of their most subordinate racial group—a phenomenon that may enhance their vulnerability to discrimination and exacerbate existing inequalities.

#### *Differences in Physiological Reactivity as a Function of Political Orientation*

To investigate the hypothesis that responses to threat are linked to political orientation, Oxley et al. (2008) conducted a physiological study involving adult residents of Lincoln, Nebraska. In a prescreening session, participants were asked about their preferences with respect to a range of policy issues, including military spending, the death penalty, the Patriot Act, school prayer, immigration, gun control, foreign aid, pacifism, gay marriage, and abortion. In a separate session, Oxley et al. measured the physiological responses of strong liberals and strong conservatives (inferred on the basis of their policy preferences) to two different types of threatening stimuli. In one task, participants viewed a series of images that included some especially threatening images (i.e., a bloodied face, a large spider on a person’s face, and a maggot-infested open wound) as well as neutral and positive images (e.g., a bowl of fruit, a cute rabbit, and a happy child). Oxley and colleagues observed that individuals who expressed more conservative policy preferences exhibited heightened skin conductance responses (SCRs)—an index of autonomic arousal—in response to negative (i.e., threatening and disgusting) images, in comparison with those who held more liberal positions. There were no ideological differences with respect to SCRs following exposure to neutral and positive images.

In a second task, Oxley et al. (2008) administered sudden, unexpected blasts of white noise and measured startle blink responses while participants regarded a fixation point on a computer monitor. More forceful contraction of the muscles surrounding the eyes typically reflects a more defensive or fearful reaction to the startling stimulus (Hess, 2009). Although participants in general exhibited reflexive eye blinks in response to noise blasts, conservatives exhibited stronger blink amplitudes than did liberals (after adjusting for demographic factors). Given that amygdala activation tends to accompany the startle reflex in response to aversive stimuli (Anders, Lotze, Erb, Grodd, & Birbaumer, 2004), it is quite conceivable that liberal-conservative differences in blinking responses reflect differences in amygdala function. However, it should be noted that a clear inference about the relationship between the amygdala and political orientation cannot be drawn on the basis of this



study, insofar as the startle response was assessed during unconstrained resting periods between trials—which is typically treated as a “baseline” measure—rather than in the context of processing emotionally relevant stimuli (see Lang et al., 1990). It is also unclear whether these responses were caused by the presentation of threatening or disgusting stimuli in particular or to negativity in general.

Indeed, left-right differences in brain and behavior have been observed with respect to disgust sensitivity. Self-reported sensitivity to disgust (especially when it comes to cleanliness and purity-related issues) is associated with the endorsement of more socially and politically conservative attitudes (e.g., Inbar, Pizarro, & Bloom, 2009; Inbar, Pizarro, Knobe, & Bloom, 2009; but see Tybur, Merriman, Hooper, McDonald, & Navarrete, 2010). Even a simple reminder of hand sanitization leads people to express more conservative (and less liberal) attitudes and judgments (Helzer & Pizarro, 2011). It appears that there are also physiological differences in sensitivity to disgust as a function of political orientation. Smith, Oxley, Hibbing, Alford, and Hibbing (2011a) measured the skin conductance of participants as they viewed disgusting images (i.e., a man with a mouthful of worms, an emaciated body, feces in a toilet, a bloody wound, and an open sore filled with maggots). They found that—after adjusting for age, sex, education, and even self-reported disgust sensitivity—participants who exhibited stronger GSR following exposure to disgusting images were more likely to oppose gay marriage and premarital sex. However, attitudes concerning other societal issues, such as free trade, foreign aid, immigration, and tax cuts, were unrelated to GSR. In summary, then, this study provided some, albeit mixed, evidence that heightened physiological sensitivity to disgusting (as well as threatening) stimuli is associated with more conservative political orientation.

Feldman (2013) has asked: “Are the effects of conflict monitoring (Amodio et al., 2007) and physiological reactions to threatening stimuli (Oxley et al., 2008) on ideology understandable from a single theoretical perspective?” (p. 618). We would answer in the affirmative. If it is true that conservative ideology, with its emphasis on tradition, hierarchy, and maintenance of the status quo, provides a better match than liberal or progressive ideology to epistemic and existential motives to reduce uncertainty and threat (Jost et al., 2003), then we would indeed expect to see neurocognitive differences involving the ACC, amygdala, and insula as a function of political orientation (see also Jost & Amodio, 2012). Indeed, we find, with Taber and Young (2013), that “the neuroimaging literature seems largely to parallel, if not outright confirm, other, typically trait- and survey-based research suggesting liberal thinking, relative to conservative, is related to greater cognitive flexibility, more empathy, and less concern with fear” (p. 541).

#### *Differences in Brain Structure as a Function of Political Orientation*

In light of robust evidence of cognitive-motivational differences between liberals and conservatives in terms of uncertainty and threat management, recent work has begun to investigate the possibility that ideological differences are manifested in neuroanatomical structures. Kanai, Feilden, Firth, and Rees (2011) hypothesized that liberals and conservatives would exhibit differences in grey-matter volume with respect to the ACC and amygdala, especially in light of evidence that amygdala volume is positively correlated with dispositional fearfulness (van der Plas, Boes, Wemmie, Tranel, & Nopoulos, 2010). In two samples of British university students, Kanai and colleagues observed that conservatism (measured in terms of ideological self-placement) was positively associated with larger right-amygdala volume (see Table 3), which is conceptually consistent with the earlier finding that conservatism is associated with greater physiological startle response to threatening stimuli (Oxley et al., 2008).

The researchers also discovered that greater liberalism (or lesser conservatism) was associated with larger ACC volume, which is conceptually consistent with the finding that liberalism is associated with greater conflict-related activity in the ACC (Amodio et al., 2007; see also Dennis



**Table 3.** Correlations Between Political Orientation and Regional Brain (Grey Matter) Volume (Kanai et al., 2011)

| Brain region   | Correlation with<br>Political Orientation<br>(Liberalism-Conservatism) |                     |
|----------------|--|---------------------|
|                | Study 1<br>(N = 90)  | Study 2<br>(N = 28) |
| ACC            | -.27**   | -.49**              |
| Right amygdala | .23*   | .38*                |
| Left insula    | .42†   | .55**               |

*Note.* This table summarizes the results of a study reported by Kanai et al. (2011). Political orientation was measured in terms of ideological self-placement on a scale ranging from 1 (“very liberal”) to 5 (“very conservative”), so that higher scores indicate greater conservatism. Correlations for both studies are based on samples of college students from University College London.

\* $p < .05$ , corrected for family-wise error (FWE)

\*\* $p < .01$ , corrected for family-wise error (FWE)

† $p < .001$ , uncorrected and cluster size larger than 50 mm<sup>3</sup>

et al., 2013; Weissflog et al., 2013). In a more exploratory analysis of the whole brain, Kanai et al. (2011) observed that conservatism was associated with larger grey matter volume in the left insula. This, too, is consistent with previous work, most notably demonstrations that conservatives are more sensitive to disgust (Inbar et al., 2009) and that the insula plays a pivotal role in the experience of disgust (Wicker et al., 2003).

To understand why there are ideological differences in regional brain volume, Nam, Jost, Campbell-Meiklejohn, and Van Bavel (2013) focused on the relationship between system justification tendencies and neuroanatomical structure in an American sample. As we noted earlier, system justification theory holds that people are motivated to defend and bolster existing social, economic, and political arrangements because doing so addresses basic psychological needs, including epistemic needs to attain certainty and order. System justification is a key aspect of political conservatism, insofar as both are concerned with resistance to change, maintenance of the status quo, and justification of inequality (Jost, Nosek, & Gosling, 2008). Given that the amygdala is associated with responses to uncertainty, threat, and other motivationally salient stimuli (e.g., Cunningham et al., 2008; Phelps et al., 2001; Whalen, 2007), Nam, Jost, Campbell-Meiklejohn, et al. (2013) hypothesized that system-justifying tendencies would be associated with greater amygdala volume. They observed that system-justification scores were indeed associated with greater bilateral amygdala volume in a sample of 48 U.S. college students (adjusting for the effects of age, sex, and overall brain volume, as well as political orientation). A path model suggested that discomfort with uncertainty mediated the relationship between system justification and amygdala volume to a marginal degree. These results suggest that system justification, like political conservatism, may be reflected in specific neuroanatomical structures.

*Differences in Resting-State Connectivity as a Function of Political Orientation*

Given that individual differences in political orientation seem to be associated with fundamental cognitive and motivational orientations (Jost et al., 2003; Oxley et al., 2008), there is reason to suppose that political orientation is also associated with the intrinsic functional architecture of the brain. Building on work showing that liberalism is associated with increased conflict-related processing in the dorsal ACC (Amodio et al., 2007) as well as increased grey-matter volume in this

region (Kanai et al., 2011), Cox et al. (2012) examined the relationship between political orientation and intrinsic functional connectivity—the interrelationship between different brain regions when people are at rest—using the dorsal ACC as a seed region. Results revealed that liberalism was indeed positively associated with intrinsic functional connectivity between the dACC and the right insula and putamen—part of a network of regions that process emotionally significant stimuli (Seeley et al., 2007). Although these results are preliminary, they are consistent with the notion that liberals may possess tighter integration of neurocognitive systems that are involved in cognitive control (especially conflict monitoring) and affective representation. Another study by Newman-Norlund, Burch, and Becofsky (2013) indicated that Democrats exhibited stronger resting-state connectivity than Republicans with respect to the so-called human mirror-neuron system, which is a network linked to a host of social and emotional abilities, including empathy. Taken together, these findings suggest that political orientation may be related, not only to specific situational responses to stimuli, but also to the intrinsic communication among brain regions, which could have broader implications for phenomena such as emotional reactivity, self-regulation, and perspective taking.

### The Dimensional Structure of Political Attitudes

Consistent with our discussion of left-right ideological differences above, a number of scholars maintain that the spatial metaphor in politics remains “a powerful summary tool” (Campbell, Converse, Miller, & Stokes, 1960/1965, p. 111) and “provides an economical mode of discourse” (Tedin, 1987, p. 67). In a similar spirit, Jost (2006) opined that “if the left-right distinction did not exist, scholars of ideology would need to invent its equivalent” (p. 130, emphasis omitted). Nevertheless, some authors have argued that two or more independent dimensions are necessary to adequately represent ideological space (e.g., Evans, Heath, & Lalljee, 1996; Feldman, 2013; Saucier, 2000). According to one proposal, liberalism and conservatism do not signify opposite poles on a continuum but are instead *orthogonal* ideological dimensions, so that people can (and do) endorse liberal ideas without being opposed to conservative ideas, and vice versa (e.g., see Choma et al., 2009; Conover & Feldman, 1981; Kerlinger, 1984).

But by far the most common multidimensional scheme focuses on ostensible differences between social (or cultural) and economic attitudes (e.g., Carmines, Ensley, & Wagner, 2012; Feldman, 2013; Layman & Carsey, 2002; Lipset, 1960; Shafer & Claggett, 1995). This distinction is related but not identical to the distinction between resistance to change and acceptance of inequality (Jost et al., 2003). A review of the literature by Jost et al. (2009, pp. 312–315) led to the conclusion that while social and economic dimensions of political orientation are clearly conceptually and empirically distinguishable, it is rare for them to be entirely orthogonal (i.e., uncorrelated) in practice.<sup>3</sup> It is rarer still for liberal and conservative attitudes to be uncorrelated, especially after adjusting for measurement error.

#### *A Neuroscientific Investigation of a Multidimensional Model of Political Attitudes*

To our knowledge, there has been only one neuroscientific study bearing on the dimensional structure of political attitudes, but it seems like a safe bet that others will follow. Zamboni and colleagues (2009) used a multidimensional (MDS) scaling technique to try to identify fundamentally distinct elements of political opinion. In one phase of the research program, they asked adult

<sup>3</sup> It is important to keep in mind that many issues—such as those having to do with welfare programs, affirmative action, and immigration policy—clearly combine both social and economic concerns, and this, too, may help to explain why opinions in the two domains are typically correlated with one another (Jost et al., 2009).

volunteers to read a very long list of political statements and, over the course of several sessions, rate the extent to which each statement was similar to every other statement. Multidimensional scaling procedures yielded three orthogonal dimensions of opinion: (1) whether one emphasizes the role of the individual (e.g., “Everybody should prioritize his or her own interest over society’s”) or of society (e.g., “Citizens should vote based on collective interest”) when it comes to politics; (2) whether one endorses liberal (e.g., “Gays and lesbians should be able to get legally married”) or conservative policy attitudes (e.g., “Everybody should oppose teaching evolutionary theory”); and (3) whether one favors moderate (e.g., “The government should protect freedom of speech”) as opposed to radical measures (e.g., “People should use violence to pursue political goals”). In a second research phase, the investigators asked a different set of participants (who varied in terms of their own self-identified political orientation) to rate their levels of agreement or disagreement with statements representing each of the three dimensions while their brains were scanned. The idea was to try to isolate the neural correlates of thinking about specific types of political ideas, independent of the participant’s own background.<sup>4</sup>

Although this approach was inherently exploratory, Zamboni and colleagues observed some potentially interesting trends. To begin with, the processing of political statements prioritizing individual (vs. societal) concerns was accompanied by activity in the vmPFC, which is a region that is associated with self-reflection (Kelley et al., 2002), as well as more general evaluative processes. By contrast, the processing of statements prioritizing societal concerns was accompanied by activity in the dmPFC, a region that is linked to social cognition and mentalizing about others (Amodio & Frith, 2006; Mitchell et al., 2002), as well as activity in the temporoparietal junction, a region that is also associated with perspective taking (Samson, Apperly, Chiavarino, & Humphreys, 2004). Second, the processing of conservative (vs. liberal) statements was associated with greater activity in the right dlPFC, a region that is linked to withdrawal motivation and response inhibition (Aron, Robbins, & Poldrack, 2004; Davidson, 1992; Harmon-Jones, 2003). Zamboni and colleagues (2009) speculated that this response was attributable to the predominantly liberal character of their sample, but they did not investigate the role of participants’ political orientation in moderating neurocognitive responses to political statements. Third, the processing of moderate (vs. radical) statements was accompanied by greater activity in the ventral striatum (as well as the posterior cingulate/precuneus). Given that the ventral striatum is implicated in reward processing (e.g., O’Doherty, 2004), Zamboni and colleagues attributed this pattern to the fact that moderate statements are more socially acceptable (and less emotionally salient) than radical statements. These last effects, in particular, may not be unique to the political domain. One might well predict that processing reasonably moderate (i.e., acceptable, noncontroversial) statements about virtually any topic would activate reward-processing centers, whereas processing extreme (i.e., unacceptable, controversial) statements would activate emotional processing in general.

The take-home message from Zamboni et al. (2009) is that different brain regions were activated when participants ruminated about each of the three different types of statements. The authors interpreted this as evidence for a multidimensional conception of political ideology. Although provocative, the results of this study should probably be treated as preliminary—largely because their methods assumed a multidimensional solution *ex ante*, and the dimensions they identified were derived on the basis of a purely inductive approach that depended heavily on the specific items that were administered. Nevertheless, we are in full agreement with the authors that cognitive and neuroscientific approaches could be extremely useful for determining whether (and for whom) ideological space is represented in terms of unidimensional vs. multidimensional structural schemes.

<sup>4</sup> Zamboni et al. (2009) treated the participant’s political orientation as a “nuisance” variable and did not report the results of any statistical models that included interaction terms involving this variable.

*Does the Cognitive System Privilege Single, Contrasting Dimensional Schemes?*

Experiments in cognitive psychology reveal that when individuals try to categorize stimuli that differ in terms of two or more underlying dimensions (such as social vs. economic liberalism-conservatism) they prefer focusing on a single dimension and using that as the basis for categorization (e.g., Ashby, Queller, & Berretty, 1999). It stands to reason that imposing a unidimensional structure helps to simplify the decision-making task, especially insofar as people find it much easier to learn and remember unidimensional than multidimensional classification schemes (Shepard, Hovland, & Jenkins, 1961). Furthermore, Davis and Love (2010) have argued that “human category formation relies on contrastive learning mechanisms” (p. 234) and that contrasts—such as that between the political left and right—may “lead to caricatures that people should find easier to process and more compelling than true categories” (p. 241). In some situations, oversimplification greatly compromises judgmental accuracy (Ashby et al., 1999), but this does not always seem to be the case. Kato and Okada (2011) observed that at least one of the two major dimensions recovered through multidimensional scaling of expert judgments of policy positions was correlated with overall left-right ideological placement in nine of the 13 countries they investigated.

Therefore, one can readily agree that the universe of political issues and opinions can only be represented *faithfully* in multidimensional space (e.g., Carmines et al., 2012; Feldman, 2013) and yet maintain that actual political actors—for cognitive as well as motivational reasons—might prefer (1) single over multiple dimensions of judgment and (2) contrasting over orthogonal methods of categorization. Consistent with this notion, Heit and Nicholson (2010, p. 1510) observed that when U.S. participants were asked to estimate how liberal and how conservative (in separate questions) a given set of politicians was, the correlation between the two ratings was an astonishing  $-.97!$  Contrary to the notion that liberalism and conservatism are mentally represented as orthogonal dimensions (e.g., Choma et al., 2009; Conover & Feldman, 1981; Kerlinger, 1984), Heit and Nicholson concluded that, subjectively speaking, “Liberal is the opposite of conservative” (p. 1513). An intriguing twist is that different perceivers may develop somewhat different unidimensional rules, depending on which values or characteristics they weight most heavily (e.g., see Benoit & Laver, 2006, pp. 31–32).

We regard these hypotheses about individuals’ cognitive preferences for single and contrasting dimensional schemes as highly deserving of research attention in the future. For instance, computational models that explicate the basic psychological processes underlying human-category formation (e.g., Love, Medin, & Gureckis, 2004) may help to identify manipulations that promote alternative conceptualizations of political categories (e.g., see Regehr & Brooks, 1995, for examples involving artificial stimuli). Such modeling efforts may also help to explain why such biases exist in terms of deeper underlying principles involved in the representation of concepts (e.g., Goodwin & Johnson-Laird, 2011). Finally, neuroscientific investigations of the brain systems involved in category formation may help to determine the extent to which political categories are actually represented in terms of single versus multiple dimensions. For example, multivoxel pattern analyses, when applied to fMRI data, have the potential to reveal patterns of similarity between neural operations implicated in the processing of different category members and may thereby help to elucidate the underlying dimensionality of such representations (e.g., Mitchell et al., 2008; Norman, Polyn, Detre, & Haxby, 2006).

### **An Agenda for Future Research in Political Neuroscience**

The application of neuroscientific theories, methods, and assumptions to the study of social psychology has already yielded novel insights and predictions that would have been difficult to develop by relying exclusively on traditional behavioral methods. For instance, our understanding of

implicit social cognition—especially when it comes to the phenomenon of implicit prejudice and prospects for its regulation or control—has improved dramatically by incorporating neuroscientific advances in research on learning and memory (e.g., Amodio & Devine, 2006; Amodio & Ratner, 2011a; Hart et al., 2000; Lieberman, 2000; Phelps et al., 2000). Discoveries in political neuroscience have also begun to challenge traditional assumptions in political science, such as the notion that ordinary citizens' ideological preferences are derived primarily (or even exclusively) through top-down, elite-driven forms of communication that are more or less passively absorbed (see also Hibbing et al., in press; Jost et al., 2009). On the basis of recent work in political neuroscience and behavioral genetics, Smith et al. (2011b) have called for a “reconceptualization” of ideology that is reminiscent of Wilson's (1998) entreaty to unify the natural and social sciences. Specifically, Smith and colleagues argue that “ideology is not a superficial label or bundle of topical positions but rather is a central component of an individual's general life orientations” (p. 378). We share these authors' commitment to the scientific integration of multiple levels of analysis, which incorporates environmental, biological, psychological, social, and political factors.

So far, there are few, if any, instances of research in political neuroscience debunking conclusions drawn on the basis of behavioral studies. In fact, much of the work in political neuroscience has provided convergent evidence for existing theoretical assumptions, which is a necessary and useful step in its own right. The field is still in a fledgling state, and there is much work to be done in refining the concepts and tools in use. At the same time, there is every reason to assume that as methodological sophistication and theoretical precision continue to increase, advances in political neuroscience will corroborate some empirical claims in political psychology while clarifying, qualifying, and supplanting others. For the time being, there is still an abundance of “low-hanging fruit” that is available to investigators. To take just one example, very few studies have explored the neural mechanisms of persuasion despite the obvious centrality of the topic in social psychology, political science, and adjacent fields. Given the importance of propaganda, political advertising, and other forms of communication to political psychology, the opportunities here are virtually unlimited. To balance our enthusiasm for the future of political neuroscience with a dose of realism, we turn now to a consideration of some of the limitations and potential pitfalls of work in this area, offering several additional recommendations with respect to future research.

### *Limitations of the Brain-Mapping Approach*

As we have seen, the first generation of research in political neuroscience has been largely exploratory, often seeking to determine which brain regions are associated with specific types of political cognition or behavior. The “brain-mapping” approach is intuitively appealing and potentially illuminating, but it is also inherently limited. The initial cohort of studies in political neuroscience is provocative because it already suggests a tentative roster of neurocognitive processes that play some role in phenomena that are central to political psychology (see Table 1 above). At the same time, we have tried to emphasize the fact that conclusions drawn on the basis of brain mapping studies tend to be speculative and subject to multiple explanations (Amodio, 2010a; Poldrack, 2006; Theodoridis & Nelson, 2012). As Cacioppo and colleagues (2003) have already warned would-be political neuroscientists, “one cannot assume that changes in brain activity are a direct, invariant measure of the neural instantiation of the investigator's favorite construct or that the contemporary neurobiological theory regarding the function of a specific brain structure or system is everlasting” (p. 653).

To take just one example from the many research programs we have summarized, the insula is indeed activated by disgust-inducing images, but the fact remains that it is a fairly large, densely interconnected brain region that is also involved in processes and functions that are entirely unrelated to disgust (Craig, 2009). Therefore, the observation that insula activation tends to occur

following exposure to a given stimulus by no means entails that people experience disgust when confronted with it. Similarly, regions such as the ACC and PFC are often triggered by tasks that require planned motor responses—that is to say, many, many tasks. This problem is compounded in political neuroscience because most studies do not elicit task-specified actions on behalf of the participant, and yet some kind of behavior is involved (even if it is only viewing candidate images or reporting political attitudes). All of this makes it especially difficult to interpret frontal cortical activations, insofar as such activations could reflect anticipated actions (e.g., voting in the next election) that are not part of the experiment itself. The next generation of studies in political neuroscience, we submit, should make better use of experimental tasks and paradigms that are functionally appropriate for assessing hypotheses about specific patterns of brain activity, and researchers must keep in mind that any mental or physical event (even resting or relaxing) will elicit brain activity of some kind.

At the end of the day, it is impossible to avoid the problem of reverse inference entirely—that is, if one wishes to interpret patterns of brain activation at all. However, it is necessary to treat such interpretations as tentative and subject to revision (Aron et al., 2007; *Nature* Editorial, 2007; Poldrack, 2006). It should go without saying, perhaps, that any behavior that is as complex and multiply determined as, say, voting for a specific political candidate or participating in a rally or demonstration must be the product of multiple neural systems operating in concert. To establish sound theoretical (and meta-theoretical) foundations for the interpretation of brain-behavior correlations, we propose that the community of political neuroscientists should adhere as scrupulously as possible to a method that we refer to as “collaborative cross-examination” across levels of analysis.

#### *“Collaborative Cross-Examination” of Neural and Behavioral Interpretations*

The best antidote that we can come up with for the problem of reverse inference (and for the pitfalls of the brain-mapping approach more generally) is to adopt an iterative method involving sequential research stages in which interpretations of neural and behavioral processes are cross-examined. The idea is that investigators should use theory and methods at the behavioral level of analysis to check on the validity of interpretations arising from the observation of neural data (and vice versa). For instance, one might begin by hypothesizing that political partisans would exhibit strong negative reactions to the faces of politicians representing an opposing party. This hypothesis would probably lead the researcher to expect an increase in amygdala and/or insula activity following the presentation of prominent political out-group (vs. ingroup) members. Now let us suppose that a given neuroimaging study yields the predicted pattern of insula activation but no evidence of increased amygdala activity. Using reverse inference, the researcher might assume that participants in this situation experienced either disgust or pain—but not fear.

However, because regions such as the insula are implicated in a wide variety of tasks and functions, follow-up research should be designed to formally tease apart these alternative explanations at the level of observable behavior. Feelings of disgust, pain, and fear should be measured or manipulated rather than simply inferred on the basis of patterns of brain activation. In this case, behavioral observations may strengthen the disgust interpretation or call it into question (or suggest additional mediating or moderating variables that might be tested using neuroscientific methods). Over time, this general approach should allow researchers to determine the value of inductive insights made on the basis of reverse inferences from brain activity through the design of behavioral studies to assess specific hypotheses and mechanisms. In this way, researchers proceed iteratively, drawing on (a) behavioral evidence to constrain neuroscientific interpretations and (b) neuroscientific evidence to constrain behavioral interpretations. The result is a decidedly antireductionistic, collaborative approach to science in which psychological and physiological methods and interpretations are regarded as equally indispensable.



*Tackling the “Chicken-and-Egg Problem” in Political Neuroscience*

Through focused testing of process-oriented hypotheses at multiple levels of analysis, the collaborative method of cross-examination may help researchers to move beyond brain-behavior correlations and to finally tackle the “chicken-and-egg problem” in political neuroscience. Jost, Noorbaloochi, and Van Bavel (in press) pointed out that on the basis of existing research it is impossible to know whether, for instance, (1) individual differences in brain structure and function effect outcomes with respect to social and political behavior, and/or (2) the adoption of social and political attitudes and behaviors leads individuals to think in certain ways, causing our brains to process information differently. The most common view is that physiological and psychological characteristics (including personality traits) are heritable, stable, and difficult to change, and so they must shape political dispositions, rather than the other way around (e.g., Hibbing et al., in press; Inbar et al., 2009; Smith et al., 2011b).<sup>5</sup> This overarching assumption has led some to conclude, quite erroneously, that social and political outcomes (such as racism and political orientation) are “hard-wired.”

We suspect that differences in neurocognitive structure and functioning are linked to a constellation of social and psychological processes that unfold over time and *both reflect and give rise to the expression of political behavior*. In other words, we favor a dynamic, recursive theoretical framework in which the connection between physiological (and psychological) functioning and political outcomes is conceived of as bidirectional rather than unidirectional. Political orientation, we submit, is the product of an “elective affinity” between the discursive, socially constructed elements of ideological belief systems and the psychological constraints, motives, and interests of those who are drawn to those belief systems, so that—as Jost et al. (2009) put it—not only do people choose ideas, but “ideas choose people” (p. 308). Therefore, we are less dismissive than other authors of the possibility that “political attitudes [could] shift a person’s general emotional dispositions” (Hibbing et al., in press, p. 27). Indeed, we would hypothesize that certain ideological narratives or frames, if they are consistently encountered and embraced, could indeed affect the individual’s psychological and physiological characteristics.

Investigating hypotheses such as this one—and finally beginning to tackle the “chicken-and-egg” problem—will require the use of multiple, innovative research methods that make it feasible to isolate causal mechanisms (Jost et al., in press). Some of the most useful methods will be experimental, including the use of Transcranial Magnetic Stimulation (TMS), which involves the local application of small magnetic fields to either activate or deactivate specific cortical regions, thereby enabling investigators to draw causal inferences about the impact of brain structure and function on cognitive and behavioral outcomes. Because TMS relies on relatively weak magnetic fields, however, its application is presently confined to outer cortical regions and cannot be used to isolate structures that are more deeply embedded inside the human brain, such as the amygdala. However, studies involving patients with brain lesions as well as pharmacological interventions—such as the direct administration of neuromodulators—can be used to examine chronic or temporary deficits in subcortical (as well as cortical) regions, and these methods will also help to isolate causal mechanisms and to suggest nonobvious methods of intervention. For instance, Terbeck et al. (2012) reported that a dose of propranolol (a beta-blocker medication that dampens amygdala activity) led to a significant reduction in implicit racial bias. Given existing research in political psychology, one cannot help but wonder if this intervention would also increase participants’ affinities for liberal or progressive ideas and opinions (e.g., see Oxley et al., 2008; Thorisdottir & Jost, 2011).

Prospective, longitudinal methods have much to offer as well (cf. Block & Block, 2006; Fraley et al., 2012; Matthews et al., 2009)—especially if researchers are able to monitor *changes* in brain

<sup>5</sup> According to a quite different, more speculative view about human genetics, the relationship between personality and political outcomes is itself spurious (Verhulst, Eaves, & Hatemi, 2012).

structure and activity over time as a function of intervening experiences. Studies of nonhuman animals have demonstrated that the brain can change quite drastically in response to training and experience (e.g., Fu & Zuo, 2011), and, increasingly, it would appear that this is true of human animals as well. For instance, compassion training alters neural responses in the anterior cingulate and anterior insula—brain regions that are associated with empathy in response to the pain of others (Klimecki, Leiberg, Ricard, & Singer, 2013).

In terms of structural changes, men who complete a four-year training program to become London taxi drivers exhibited increased grey-matter volume in the posterior hippocampus, along with significant changes in memory capacity (Woollett & Maguire, 2011). Although there are limitations to what can be concluded on the basis of existing research (see Thomas & Baker, 2012), some changes in brain structure have been observed following training in a variety of domains, including exercise (Erickson et al., 2011), academic instruction (Ceccarelli et al., 2009), second-language acquisition (Mechelli et al., 2004), musical training (Hyde et al., 2009), golfing (Bezzola, Mérillat, Gaser, & Jäncke, 2011), and juggling (Boyke, Driemeyer, Gaser, Büchel, & May, 2008; Draganski et al., 2004). Of course, at this point one can only guess about the neurological consequences of watching Fox News or PBS Newshour for years at a time, but evidence from cognitive neuroscience suggests that repeated experiences may be capable of altering the structures and functions of the human brain.

### Concluding Remarks

These are early days, to be sure, for the study of political neuroscience. At the same time, there is already enough theoretical, methodological, and empirical convergence to be enthusiastic about prospects for future research. We find ourselves in hearty agreement with Taber and Young (2013), who declared that: “The explosion of findings in automaticity and brain-imaging research relevant to opinion formation represents a strong step in the direction of *explaining what we believe with how we think*” (p. 549, emphasis added). This description aptly characterizes research on all four of the key topics that we have focused on this chapter, namely: (1) the role of the amygdala in racial perception, categorization, and bias, and the role of the dACC and IPFC in detecting and overriding intergroup bias; (2) the role of the amygdala, insula, and ventral striatum in encoding partisan preferences and responding to political out-group members; (3) the nature of left-right (or liberal-conservative) differences in political orientation and how these differences might manifest themselves in terms of brain structure and function, especially when it comes to the ACC, amygdala, and insula; and (4) the dimensional structure of political attitudes and the extent to which research in cognitive neuroscience can shed light on the question of whether individuals might harbor preferences for single and contrasting dimensional schemes (such as the left-right dimension). It would be virtually impossible to predict the major themes of research that are likely to take hold in political neuroscience over the next decade or two. From our point of view, this unpredictability is something to savor and perhaps to celebrate, insofar as the scientific method is most powerful when it is used for something more than peering around the next corner. Perhaps those who like to know what is foreseeable, however, can take some solace from this most sanguine of predictions: There will be far more and, in all likelihood, far more revealing studies carried out in political neuroscience in the years to come.

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