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Is political cognition like riding a bicycle?

How cognitive neuroscience can inform research on political thinking

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Abstract

This paper proposes that understanding of political phenomena including political attitudes and political sophistication can be enriched by incorporating the theories and tools of cognitive neuroscience. In particular, the cognitive neuroscience of nonconscious habitual cognition (akin to bicycle riding) and various memory systems are reviewed in order to describe the different types of informational blocks out of which different types of political attitudes may be built. A Reflection-Reflexion model is then presented which describes how these building blocks combine to produce political attitudes as a function of goals, primes, expertise, and inherent conflict in considerations relevant to the attitude. The ways in which neuroimaging methods can be used to test hypotheses of political cognition are reviewed. Finally, the paper concludes with a discussion of important concerns for researchers investigating the neural bases of the political mind.

Is political sophistication like riding a bicycle?
How cognitive neuroscience can inform research on political thinking

Scholars since Plato and Aristotle have asked themselves many questions about the intriguingly political nature of the human mind. It is unlikely, however, that many have asked themselves whether political thinking is like riding a bicycle. This isn't altogether surprising, of course, given that casting a vote and pedaling down the road seem like very different behaviors. Beneath this surface dissimilarity, however, in many circumstances political thinking and bike riding may depend on flexing a common set of mental muscles. These muscles support the formation and expression of habits across a variety of domains (Lieberman, 2000).

Three characteristics of habitual behaviors suggest striking parallels between riding a bike on the one hand and political decision-making and attitude expression on the other. First, both can become routinized and automatic with behavioral repetition. This automaticity leads to the second parallel – once formed, it is difficult to explain exactly how these habitual behaviors operate. Just as it is difficult to consciously access and describe the coordinated movements that underlie riding a bike, the bases for decision-making in many domains become less accessible to conscious inspection over time. Third, the fact that we have imperfect introspective access to the mechanisms supporting habitual behaviors means that we can lose sight of the forces that trigger and guide their automatic expression. Decades of social psychological research, in fact, have documented myriad ways in which thoughts, preferences, and attitudes are influenced by subtle contextual factors, prior habitual thought patterns, and current mood (Anderson et al., 1988; Chaiken, Liberman, & Eagly, 1989; Forgas, 1995; Iyengar, 1997; Miller, 1991; Petty & Cacioppo, 1986; Rogers et al., 1997; Wegner & Bargh, 1998). In like fashion, many factors that shape the way we ride a bike, including tire size and inflation, handle-bar position, the weather and terrain, all can change how we ride, but may do so without any blip on our conscious radar.

But here is where the parallels end. In the case of riding a bicycle, most would realize that we can't easily or accurately explain, "exactly how" we manage to roll down the road without falling. Indeed, anyone who has tried to teach another person how to ride knows how poor explanations of habit can be. In the case of political thinking, however, and the expression of thoughts, preferences, and attitudes more generally, people often are unaware of how little insight they have into their own decision-making processes. In other words, they don't know what they don't know. The experimental literature on introspection has shown time and again that people confidently generate post-hoc narrative accounts of the thinking that supposedly went into a behavior, even when their behavior can be demonstrated to be driven by factors outside their conscious awareness (Gazzaniga, 1995; Nisbett & Wilson, 1977). Thus, behavior is often driven by automatic mechanisms, which leads self-report of mental processes to be notoriously unreliable and susceptible to many forms of contamination (Bem, 1967; Wilson & Brekke, 1994).

With this discussion of habit in mind, the importance of bike riding for political thinking becomes apparent in at least two ways. First, it suggests that a fruitful means for understanding the processes underlying various kinds of political thinking may come through the application of methods and theories used to understand mental habits in general. Second, it suggests that traditional research methods in this domain, which typically rely on self-report surveys, might not be able to provide a full explanation of political attitudes, beliefs, and decision-making. This is not to suggest that models of political thinking that emphasize either deliberate choice or the complete lack thereof (Achen, 1975; Converse, 1964) are incorrect. Rather, we mean that an alternative approach to traditional models may take as its starting point the notion that there are numerous mechanisms of attitude construction and decision-making - some of which are conscious and deliberative, and some of which are nonconscious and habitual. On this account, exciting directions in political attitude research can involve determining (a) the computational properties of each of these mechanisms, (b) when each mechanism is likely to be invoked, (c) how these mechanisms interact with one another, and (d) how the properties of these mechanisms and their interactions change with increasing political sophistication.

In this paper we take a stab at providing just this sort of account of political attitudes. In so doing, we hope to show how the methods and theories of cognitive neuroscience might be used to carve political attitude mechanisms at their proverbial joints (Ochsner & Lieberman, 2001). We begin by reviewing issues in the political attitude and political sophistication literatures with an eye towards the ways in which they represent expressions of cognitive habits. Next, we consider the way in which cognitive neuroscience theory can be used to generate hypotheses about the mechanisms underlying political behavior by 1) describing how different forms of memory provide the blocks out of which different types of attitudes may be built, and 2) presenting a reflection-reflexion model of behavioral control that describes how these building blocks combine in the construction of various forms of social – and in this case, political – cognition (Lieberman, 2002; Lieberman, Gaunt, Gilbert, & Trope, 2002). We then move from the abstract to the concrete by suggesting ways in which neuroscience methods, and in particular functional imaging, can be used to test hypotheses about political behavior. We conclude with discussion of important concerns for researchers who already have, or are about to have, embarked upon investigating the neural bases of the political mind.

Habitual Cognition: The Power Behind Two Types of Political Thinking

Political Attitudes

Assessing political attitudes through voting is at the very core of any democratic society. Similarly, politicians, activists, and the media survey the public relentlessly in order that the will of the people can be known. Many assume that these votes and survey responses reflect the actual beliefs, desires, and intentions of the public. Converse (1964) turned this assumption on its head when he suggested that for the most part, people do not have political attitudes at all and essentially perform a mental coin flip when answering surveys. He provided evidence that there is surprisingly little consistency in the survey responses given at different times by the same individuals. As this viewpoint is anathema to democratic values it is not surprising that Converse's work has led to a stream of reinterpretations and alternative accounts of political attitudes.

Achen (1975), in a move reminiscent of Brunswik's Lens model of decision making (1956), suggested that political attitudes are quite stable and that the instability of survey responses arises primarily from measurement error and item ambiguity. That is, if the form of survey items does not match the form of stored attitudes, difficulties in mentally translating from one to the other may account for different attitude reports at different times. By this account, the attitudes themselves are stable, but the ability for survey items to tap those attitudes is not. Achen suggested that measurement error should lead to reduced correlations between separate assessments that do not vary with the inter-assessment interval, whereas instability in the attitudes themselves should result in correlations that decrease with increasing inter-assessment intervals. Achen provided data to support the former view.

More recently, Zaller (1990; Zaller & Feldman, 1992) has taken a more social cognitive view of political attitude assessment. He has suggested that most people have multiple considerations (i.e., facts and beliefs that could be considered) that are potentially relevant to most survey items. What varies from time to time is which considerations are accessible (Higgins & King, 1981) to consciousness at the moment that an attitude must be provided. Thinking takes effort and consequently most of the time individuals make judgments based on the information that comes easily to mind without conducting an exhaustive search of memory for all relevant knowledge and beliefs. This type of "lite" thinking (Gilbert, 1989) has been referred to as heuristic (Chaiken, Liberman, & Eagly, 1989; Tversky & Kahneman, 1974), peripheral (Petty & Cacioppo, 1986) or pseudodiagnostic (Trope & Liberman, 1996). In contrast, thinking that invokes a more exhaustive search for relevant information has been referred to as systematic (Chaiken, Liberman, & Eagly, 1989), central (Petty & Cacioppo), or diagnostic (Trope & Liberman, 1996). Heuristic thought allows conflicting considerations to go unnoticed unless the conflicting considerations are each highly accessible at the same moment. Depending on current goals, recent mental activity, and the structure of the survey items, different considerations are likely to be active at different times leading to different attitude responses without any changes in the enduring dispositions and mental representations in the mind of the respondent.

Recently, Lieberman and colleagues have argued that conscious heuristic cognition and nonconscious habit cognition (i.e., akin to bicycling, described above) can often lead to similar outputs, though not without important differences (Lieberman, et al., 2002). In both cases, recent goals, thoughts, and contexts will bias the attitude construction process. However, having the cognitive resources and motivation to be accurate and accountable will affect the extent to which conscious attitude construction is heuristic or systematic, but these factors should not affect the role of habit cognition (Wegner & Bargh, 1998). Furthermore, nonconscious judgment processes tend to be more affective than conscious heuristic processes. Whereas conscious heuristic processes can be influenced by affect (Damasio, 1994; Forgas, 1995), nonconscious judgment processes are evaluative or affect-based at their core. Finally, the extent to which nonconscious habit cognition can easily generate a coherent response will affect the likelihood that conscious cognition occurs at all, whether heuristic or systematic. For the most part, conscious cognition is only set into motion when other aspects of nonconscious cognition sound an alarm that something has gone awry (Whitehead, 1911). For example, when nonconscious habit cognition cannot accommodate the conflicting considerations activated in response to a survey item, the brain has a mechanism for sounding an alarm that will engage conscious cognition. Consequently, the number of conflicting considerations accessible for the individual, and the degree to which the neural networks can temporarily smooth over these conflicts, will play a major part in determining which mental mechanism(s) contribute to the reported attitude.

Political Sophistication

Political sophistication is the process of gaining and ultimately possessing expertise in one or more domains of political thinking, and it also may play an important part in how both conscious and nonconscious mechanisms of attitude generation operate. Political sophistication has been a central topic for democratic institutions for centuries. Federalists such as Alexander Hamilton were against the notion of all citizens voting in elections because they believed that most people lacked the requisite expertise to make informed decisions (Wright, 1996). Only those who are politically sophisticated were thought to be reliable consumers of political issues and thus in a position to make meaningful decisions. Unlike Converse (1964), Hamilton presumably believed reliable attitudes exist and could be developed, but only by some of the people some of the time. In many ways this view is even more abhorrent to a democratic society, and yet many would admit there is a grain of truth to Hamilton's position. When the topic is shifted from politics to virtually any other domain, most are quite willing to hand the decision making over to experts. We allow wine stewards to choose bottles for us, a panel of judges to choose our figure skating champions, and weathermen to make sense of satellite data. In each case, many will disagree with particular decisions made by experts but few would prefer to turn the decision-making process over to the masses. It is unlikely that we would have more accurate weather forecasts if the forecasts were made by having everyone cast a vote.

The reason we leave these decisions in the hands of the judges is at least threefold. First, there is the simple issue of pragmatics. Collecting everyone's vote on each bottle of wine would be difficult to implement fairly, time consuming, and prohibitively expensive. Second, and more importantly, there are essential features of wine appreciation that must be learned systematically with practice and guidance. Experts' sensory representations of wine are more differentiated and their linguistic representations of taste are more in line with the actual features that determine taste (Solomon, 1990, 1997). Many of these important factors are likely to be lost on the novice wine taster. Research by Wilson and colleagues (Wilson et al., 1993; Wilson & Schooler, 1991) suggests that when novices have to provide explicit reasons for their preferences, they tend to focus on features that are easily described in words rather than the features that contribute to their natural preferences. Indeed, novices later regretted their preferences if they had originally been required to express them linguistically. Third, experts ideally are trained to dispassionately make distinctions based on objective considerations rather than ideological, national, or personal considerations. Although in exceptional circumstance judges may be swayed by bribes or love of country, their training and experience may enable them to focus on the 'facts,' more so than a novice.

The latter two reasons for choosing decision by expert over decision by mass vote depend enormously on how expertise alters the acquisition and application of affective and cognitive responses. We all know that habits like riding a bicycle benefit from practice. And, amount of practice is highly correlated with degree of expertise (Gladwell, 2002) in a variety of cognitive domains as well. Practice results in the isolated steps in a process becoming a seamless single unit that requires little conscious effort to implement (James, 1890). Relationships between relevant thoughts and beliefs form strong associations with repeated exposure (McClelland, McNaughton, & O'Reilly, 1995). At the same time, conscious judgment strategies also change with expertise such that a larger arsenal of combinatorial and logical rules can be employed and more remote consequences can be considered (Damasio, 1994) in order to consciously integrate a wider net of considerations (Zaller & Feldman, 1992).

Regarding expertise leading to more dispassionate judgments, it is not so clear that our intuitions are correct. While it is not strictly accurate to suggest that conscious judgment processes are information-based and nonconscious judgment processes are affect-based, this characterization is not altogether wrong either. Consequently, as expertise increases the efficiency of both conscious and nonconscious judgment processes, people have the capacity to make judgments that are <u>more</u> or <u>less</u> affectively-based depending on the extent to which conscious or nonconscious mechanisms are called upon during the judgment process. Survey methods and item content that systematically manipulate the judgment mechanisms relied upon could therefore come to very different conclusions about the impact of political sophistication on political judgments.

A Theoretical Framework for Conceptualizing the Brain Bases of Political Behavior

An understanding of the neural bases of political behavior can take as its starting point the bounty of existing work from cognitive neuroscience and social psychology that implicate particular brain regions in processes likely to be important for political attitudes, sophistication, and the like. In this section, we first describe the way neurally and functionally distinct memory systems provide the representational blocks out of which attitudes and other cognitive phenomena can be built. We then describe a theoretical framework for understanding dynamic interactions among these building blocks during conscious deliberative and nonconscious habitual forms of social cognition.

<u>Multiple memory systems</u>

There is now something of a catalogue of different kinds of memory and the neurocognitive systems subserving them. While it is beyond the scope of this article to review all of them (see Squire & Knowlton, 1995), several are relevant here because they likely process and store different forms of attitudes as well as different forms of memory. By knowing where different kinds of attitudes are formed and represented, we can then use neuroimaging and neuropsychological techniques to know which kinds of attitude processes are involved in producing an attitudinal response under various different conditions. Furthermore it is possible to map out how these different systems are more or less involved in attitude construction with increasing political sophistication.

Episodic memory depends critically on the medial temporal lobe for the storage of experiences as tied to particular places, times, and people. Semantic memory is largely dependent on lateral and inferior temporal cortex (Garrard & Hodges, 1999) and consists of facts about the world without respect to the context in which they were learned. 'The fork goes on the left' is an example of semantic knowledge while remembering the moment one's grandmother said this many years ago is an episodic memory. Patients with damage to the left lateral temporal cortex lose their knowledge of semantic facts, but tend to retain their episodic memories (Graham, Simons, Pratt, Patterson, & Hodges, 2000).

It is likely that episodic and semantic memories constitute many of the considerations implicated by Zaller (1990) in attitude formation. Political issues are often relevant to us precisely because of the personal experiences we have had (e.g., discrimination) that are encoded as episodic memories. Similarly, the facts that we learn about any issue are likely to be stored as semantic memories. Thus, the extent to which lateral versus medial temporal cortex is active during political attitude assessments may reveal the extent to which individuals retrieve personal experiences or learned facts and this can be done without ever asking the participant to list the thoughts relevant to their attitude, a procedure that is contaminated by having just provided the attitude measure itself (Nisbett & Wilson, 1977).

The amygdala, a small almond-shaped subcortical structure in the brain, is largely responsible for the formation of conditioned fear associations. Numerous studies have shown that damaging this region in rats prevents the formation of new fear associations and eliminates existing ones (LeDoux, 1996; for a human lesion study see LaBar, LeDoux, Spencer, & Phelps, 1995). In the human neuroimaging literature, amygdala activations are typically associated with negative affect and avoidance processes. While some have thought that the amygdala might be similarly involved in both positive and negative affect, a review of all extant neuroimaging studies of affect suggest that the amygdala plays a decidedly more significant role in negative affective processes (Luan Phan, Wager, Taylor, & Liberzon, 2002; Tabibnia, 2002).

Importantly, the amygdala has been shown to be activated by subliminal presentations of negative attitude objects (Morris, Ohman, & Dolan, 1999, Whalen, et al., 1998) suggesting that the amygdala can process negative attitudinal information outside of conscious awareness. Moreover, while Caucasian participants have shown amygdala activations in response to African-American faces in a number of studies (Cunningham et al., 2001; Hart et al., 2000; Lieberman, Hariri, & Bookheimer, 2001; Phelps et al., 2000), one of these studies (Phelps et al., 2000) showed that the magnitude of the amygdala's response was predicted by implicit, but not explicit, attitude measures. This suggests that the amygdala plays an important role in nonconscious attitude processes.

The basal ganglia, a set of large subcortical structures, appear to complement the amygdala by primarily responding to stimuli towards which we are favorably predisposed. The basal ganglia respond to desired objects in the world whether they are images of loved ones (Bartels & Zeki, 2000), payouts during gambling (Knutson et al., 2001), or an addict's drug of choice (Breiter et al., 1997). While the basal ganglia do occasionally respond to negative stimuli as well, the basal ganglia are the structure of the brain that has the highest ratio of responses to positive relative to negative affective stimili (Luan Phan et al., 2002; Tabibnia, 2002). Lieberman (2000) has argued that the basal ganglia are critical for social intuition and has recently provided neuroimaging evidence (Lieberman, Chang, Chiao, Bookheimer, & Knowlton, 2002) that the basal ganglia are involved in nonconsciously sequencing chains of information that lead to desired outcomes. Gray (1991; see also Depue and Collins,1999) has similarly argued that the basal ganglia, in conjunction with the dopaminergic neurotransmitter system, are the source of approach motivation. This suggests that the basal ganglia, like the amygdala, may be critical in the processing of nonconscious aspects of attitudes.

<u>The X- and C-Systems</u>

Given that we can remember and retrieve various sorts of experiences and emotions, how do we make use of this information when making judgments and decisions? Building on similar two-process theories, Lieberman (2002; Lieberman, Gaunt, Gilbert, & Trope, 2002; see also Ashby, Alfonso-Reese, Turken, & Waldron, 1998; Chaiken, Liberman, & Eagly, 1989l McClelland, McNaughton, & O'Reilly, 1995; Petty & Cacioppo, 1986; Sloman, 1996) has developed a neural process model of automatic and controlled social cognition that may help shed light on this question.[1] In this model, two multi-structure neurocognitive systems are posited. The X-system (named for the 'x' in reflexion), consisting of lateral temporal cortex, amygdala, and basal ganglia, spontaneously and often nonconsciously integrates current goals, context, perceptions, and activated cognition into a coherent whole that guides the stream of consciousness and current behavior. The C-system (named for the 'c' in reflection), consisting of prefrontal cortex, anterior cingulate cortex and the medial temporal lobes, is recruited when the X-system fails to create coherent outputs from the different sources of input. The anterior cingulate is the gateway to the C-system and serves as an <u>alarm system</u> that monitors the coherence of X-system processes (Carter et al., 1998, 2000; Rainville et al., 1997). Once activated, the anterior cingulate sends a signal to prefrontal cortex alerting it that a conflict has been detected requiring conscious attention and effort in the form of working memory and propositional processes. The separate functions of the X- and C-systems necessitate or at least follow from the different computational properties of each system. The X-system is constantly integrating information from many sources simultaneously and thus is best served by connectionist networks that operate in parallel with great speed and efficiency (Read, Miller, & Vanman, 1997; Smith, 1998). The X-system tends to overlook small discrepancies between activated cognitions and actually fills in information implied by, but not actually present in, the input. (Schank & Abelson, 1977). The C-system operates serially, focusing on only a few pieces of information at a time. Because the C-system is typically activated by a processing error in the X-system there typically is only a single issue that requires attention and thus the seriality of the C-system may not be a limitation when called upon. The C-system specializes in keeping pieces of information as distinct symbolic representations (Deacon, 1997; O'Reilly, Braver, & Cohen, 1999) that can be flexibly combined and contrasted according to any number of logical syntax. While the X-system depends primarily on the associative links formed through extensive learning histories, the C-system can construct arbitrary associations between pieces of information as demanded by the current context. Moreover, the C-system's effectiveness is driven by motivational factors and the extent to which the individual can devote conscious resources to the task at hand. Either low motivation or scant cognitive resources can make the C-system more likely to provide heuristic outputs, whereas high motivation and copious cognitive resources can lead to more systematic C-system outputs.

According to this model, the C-system is usually only involved to the extent that the X-system fails to resolve the current set of inputs into a coherent output. As previously mentioned, the X-system is able to resolve small discrepancies without assistance and usually does this by shifting one or more attitudes or beliefs to provide greater fit with the others. Contrary to some theories of attitude formation (Anderson, 1974), Spellman and Holyoak (1993; Shultz & Lepper, 1995; Holyoak & Simon, 1999) have shown that attitudinal considerations do not always exist independently in the mind and instead change their weight and meaning in order to fit with the most coherent group of considerations. For instance, in one study Spellman and Holyoak found that attitudes towards the Gulf War were predicted by intercorrelated considerations including attitudes towards pacifism, legitimacy of intervention, isolationism, and towards Saddam Hussein. Interestingly, change in attitudes towards the war as assessed across two timepoints also led to the corresponding changes in all four categories of attitude considerations. In other words, the overall attitude and its constituent considerations constrain one another such that changes in one tend to promote changes in all.

While this work examined attitude formation and attitude shifts in general, we (Lieberman, Ochsner, Gilbert, & Schacter, 2001) have recently examined the neurocognitive systems involved in these coherence giving attitude shifts. We argued that the kind of connectionist processing characterized in the above studies by Holyoak and colleagues should be implemented in the X-system rather than the C-system. To test this, we selectively removed the contributions of the C-system to determine if this kind of attitude shift could still occur. In one study, we tested whether amnesic patients with severely impaired episodic memory, a component of the C-system, would still show these coherence-related attitude shifts. These patients actually showed as much or more change in their attitudes than control participants with intact episodic memory. We then conducted a second study in which we put participants under cognitive load while they were engaged in the attitude task. Cognitive load entails performing a second task in combination with the primary one. In this case, the secondary task involved keeping track of the number of tones of a particular frequency within a stream of different tones. Load vastly diminishes the contributions of prefrontal cortex to conscious deliberation by diverting working memory resources elsewhere. As in the previous study, these cognitively loaded participants showed just as much attitude change as the participants who were not under cognitive load. This suggests that these coherence-based attitude shifts can occur without the contributions of the C-system.

Nevertheless, if the conflict between different considerations is too large, the C-system will detect this tension in the X-system and become involved (Botvinick et al., 2000). It is with the involvement of the C-system, when explicit considerations can be taken into account and integrated with one another, that Zaller's model (1990) of attitude construction fits best. Zaller's model explains how the C-system should operate under conditions of low motivation, incorporating only easily accessible considerations into self-reported political attitudes. This low motivation condition aptly describes the average participant when they are interrupted from other concerns to answer survey items. With increasing motivation to be accurate and accountable, however, we should see a more complete inclusion of relevant considerations into the reported attitude.

Using cognitive neuroscience theories to generate hypotheses about political phenomena

The X- and C-system framework for conceptualizing brain systems used for automatic and deliberative social cognition can be used to develop a number of different hypotheses about the roles these systems play in political behavior. To reiterate, these are hypotheses meant to suggest the utility of a cognitive neuroscience approach, rather than conclusions that are well supported already. First, building on the divide and conquer approach to memory systems, this model suggests that there are several distinct mechanisms of attitude formation and judgment. These mechanisms have different properties from one another in terms of the informational inputs to which they are sensitive, the computations performed on active representations, as well as the regions of the brain to which process outputs are delivered. Consistent with most dual-process models of social cognition (Chaiken & Trope, 1999; cf Kruglaski et al., 2002) we organize these different processing mechanisms according to the extent to which they are consciously accessible and associated with effortful processing of propositional statements. C-system processes tend to be more consciously accessible, serially processed, and linguistically organized, whereas X-system processes tend to be less consciously accessible, processed in parallel, and non-symbolic in their structure. At the very least, this suggests that priming, goals, and survey factors that are thought to change the nature of attitude report could be effectively studied with neuroimaging techniques.

Additionally, the X- & C-system model suggests a new important factor that should determine which processing mechanisms are involved. Dual-process models typically point to motivation and cognitive resources as determining the extent to which conscious deliberative processing will be invoked (Chaiken & Trope, 1999). Our model suggests that the extent to which the X-system can automatically generate a coherent interpretation of competing inputs (context, goals, factual considerations) will determine whether or not a conscious, deliberative processing mechanism is invoked. Moreover, the X-system is capable of smoothing over small amounts of conflict between representations, suggesting that important facts that conflict with the rest of the considerations may well be ignored after being initially active.

Political sophistication is likely to play a role in the degree to which the X-system can tolerate conflict. As sophistication increases, the representations of the X-system are likely to become increasingly integrated with one another providing a stronger shield against potentially conflicting representations. Furthermore, as sophistication increases, the activation of favored considerations in the X-system is likely to recruit other consistent considerations more efficiently. Alternatively, increasing sophistication may produce C-system processes that are more capable of detecting subtle conflicts between considerations that would escape the notice of the novice. As with all C-system processes, the extent to which this C-system detection would be relevant depends on the motivation and availability of cognitive resources to devote attention to these subtle conflicts. An expert motivated to reach a particular outcome would not be expected to make use of this enhanced detection ability when the conflicts would undermine their arguments (Kunda, 1990).

Finally, we speculate that political sophistication should interact with the degree of consideration conflict in determining the role of affect in self-reported attitudes. That is to say, political sophistication may not primarily produce main effect differences in attitudes. Expert X-systems may produce more affect-laden attitude reports (McGraw & Pinney, 1992), while expert C-systems can produce attitudes derived from the logical conclusions generated by activated considerations. If survey measures and survey contexts randomly promote X- or C-system processing, the effect of expertise might be missed. Alternatively, consistent use of methods biased towards X- or C-system processes may produce an incomplete and skewed understanding of expertise effects. Only by intentionally and systematically manipulating the factors that determine X- vs. C-system processing (e.g., degree of consideration conflict) can we expect to see the effects of political sophistication in the clear light of day. In other words, when the conflict between activated considerations is low, the X-system is likely to be the primary contributor to self-reported attitudes, and as such may produce increasingly affect-based attitudes with sophistication. Alternatively, when the conflict between considerations is high, the C-system should be recruited and able to produce attitudes that follow an increasing degree of objective rule-based logic with increasingly levels of political sophistication.

Using cognitive neuroscience methods to test hypotheses about political phenomena

There are many methods used by cognitive neuroscientists to examine the brain bases of cognitive and emotional processes, ranging from recording electrical potentials on the scalp (e.g. Cacioppo, Crites, & Gardner, 1996), to studying the behavioral deficits of neuropsychological patients with brain lesions (e.g. Corkin, 1968), to recording from electrodes placed deep inside the brain (Kawasaki et al., 2001). It is beyond the scope of this article to consider the possible uses of each method for addressing questions about political attitudes, and here we focus on the use of one technique in particular, known as functional neuroimaging. But before diving into a discussion of what functional imaging <u>can</u> do, it is important to briefly mention what it <u>cannot</u> do. Functional imaging (or any other neuroscience technique, for that matter) should not be seen be seen as providing a readout of what "really," is going on in the mind. Far from it, in fact. Like the experimental techniques already familiar to political scientists, such as self-report and response time, functional neuroimaging depends upon a number of assumptions about the relationship between a dependent measure and the psychological processes whose operation it putatively reveals. Unlike purely behavioral measures, however, functional imaging provides data that can inform both theories of brain function and psychological process simultaneously. With these caveats in mind, there are a number of ways that functional neuroimaging can make important contributions to the study of political attitudes, just as the use of reaction times (Fazio, 1989) and memory clustering measures (McGraw & Pinney, 1992) have in the past.

First, imaging could be used to identify the use of common or dissimilar processes during the expression of different types of attitudes (Cacioppo, Crites, & Gardner, 1996). For instance, participants could be asked to provide their attitudes on political issues that range from community to global politics to examine whether different systems are systematically invoked as a function of attitude target and personal knowledge of the target in question. Another possibility would be adapt methods used by Schuman and Bobo (1988), and order test items such that some activate (i.e., prime) particular issues and considerations that could influence judgments made on subsequent items. The idea would be to compare brain activation to judgments made on the subsequent items primed in ways that could hypothetically lead to the construction of different types of attitudes. For instance, are different neural systems recruited when reporting one's attitude towards affirmative action as a function of whether the previous question primed racial fears or principles of fairness? Fear-based primes might increase reliance on the X-system, while fairness-based primed might lower the conflict threshold at which the C-system starts contributing to the construction of an attitude.

A second use of imaging could involve idiographic studies, in which experimenters identify participants based on the extent to which they are motivated to come to certain conclusions about particular issues (Kunda, 1990), are motivated to carefully produce a defensible conclusion (Tetlock, 1985), or the extent to which they have competing considerations surrounding the issues of interest. Individual differences in cognition can influence the "tuning," of brain systems and their associated processes, and insight could be gained into the nature of this tuning by determining whether and how patterns of brain activation change during political attitude expression as a function of theoretically-relevant individual differences.

Finally, neuroimaging is an excellent technique for identifying changes in processing that occur during learning of various kinds of skills (Poldrack et al., 2001), and could similarly provide insight into the changes that occur with growing political sophistication, either in general, or with respect to a particular issue. Initial cross-sectional studies could compare, for example, how political sophisticates process survey items differently than political novices

(Schreiber & Iacoboni, 2002), potentially revealing reliance either on distinct learning systems (e.g. the X as opposed to the C systems, respectively) or differential engagement of the same systems (e.g. greater access of episodic memories by novices, who consult memories of individual experiences when making judgments). Subsequent longitudinal studies could track changes within individual participants by scanning individuals before and after taking intensive undergraduate or graduate course focusing on particular issues to more precisely track when and how reliance on different learning and control systems takes place. Poldrack (2000) has recently reviewed a number of the issues involved in studying changes across time within individuals that could provide a useful guide for researchers interested in following this path.

This list of ways in which neuroimaging could contribute to the understanding of political attitudes and political sophistication is not meant to be exhaustive. Indeed, it is more of an hors d'ouvre than an entrée, and is meant to whet the appetite for further explorations of what might be possible. The difficulty of pulling off the collaborative work necessary conduct such studies should not be underestimated, however, and in the final section we outline some important concerns for researchers interested in bridging the gap between the potential and the reality of interdisciplinary work.

Concluding Concerns for a Cognitive Neuroscience of Political Issues

The preceding review described some of the conceptual tools and research questions that could be important for cognitive neuroscience research on political issues. As was hopefully demonstrated, much work already has addressed systems used for emotion and social cognition, and a fruitful path for a cognitive neuroscience of politics could take as its first step the determination of whether and how these systems participate in various forms of political cognition. In this section we identify six inter-related issues, topics, and themes that may be of central concern as research of this kind takes wing.

1. Connecting Colleagues

Looming large is the need for members of heretofore foreign disciplines to collaborate, and in order to do so they must learn to speak one another's specialized languages. In order for political scientists to use neuroscience methods, they will have to acquire a working vocabulary of foreign concepts including neuroanatomical terms such as prefrontal cortex and hippocampus, and will have to learn techniques such as functional magnetic resonance imaging. And the same is true for cognitive neuroscientists who wish to use study political and related social cognitive phenomena. They will have to learn about attitudes, stereotyping, political sophistication, and how to manipulate mood and motivation. It bears repeating that the benefits of these efforts are wholly practical and that each field has much to offer the other. Time and again, cognitive neuroscience has shown how knowing about the brain informs research on, and refines theory about, psychological processes (e.g. McClelland et al, 1995; Ochsner & Kosslyn, 1999; Posner & DiGirolamo, 2000; Schacter, 1992), and theories of political psychology may similarly be refined.

It is important to note that the foundation for communication between disciplines may involve the use of a common information processing vocabulary. Many concepts such as schema, selective attention, and implicit and explicit processing, can use used to describe the processes that support central phenomena in both fields. The common usage of such terms can allow descriptions of cognitive processes to be used as the "Rosetta Stone" for interdisciplinary work, translating foreign terms into a common information processing parlance.

2. Linking Levels

The upshot of collaborative study should be the construction of theories of behavior that take into account multiple levels of analysis, an aim that has been championed time and again in the last decade of psychological research (e.g. Cacioppo & Berntson, 1992; Ochsner & Kosslyn, 1999; Posner & DiGirolamo, 2000; Schacter, 1992). Doing so can result not only in theories that account for more data more flexibly and more robustly, but can help generate new hypotheses about the relationships between levels as well (Sarter, Berntson & Cacioppo, 1996 and see below). Elsewhere, we have argued that there are three interdependent levels (Ochsner & Lieberman, 2001): The phenomena investigated at the social level specify ways in which variations in social status, beliefs, attitudes, motivational state, and other situational variables evoke different kinds of processing (Gilbert et al, 1998). The cognitive level explains what those processes are and how they interact. And hypotheses about these processes can be constrained by neural level data about the structure and function of the brain (Kosslyn, 1994; Ochsner & Kosslyn, 1999; Posner & DiGirolamo, 2000; Schacter, 1990, 1992).

3. Cross-level Constraints

Progress using a multi-level approach will hinge on the use of data couched at one level of analysis to constrain about the understanding of data at other levels. These constraints can operate both from the top down – as different situations, contexts, motivations and goals evoke (and bias) different constellations of basic processes – as well as from the bottom up – as brain data can be used to determine which processes are involved in, or are necessary components of, particular behaviors. For example, the processes invoked when a white candidate asks a black man for his vote could be very different depending upon whether the black man construes the white candidate as Caucasian or as just another guy. In this scenario and countless others, numerous factors influence what kind of construal is made, some of them passive byproducts of informational exposure and processing, and some of them motivated by self-protective, self-regulatory, or other goals (Greenwald, 1980; Higgins, 1999; Nisbett & Ross, 1980; Taylor & Brown, 1988). And as illustrated in the above review, imaging and other neuroscience methods can be used to infer when and how affective, evaluative, inhibitory or other kinds of processes play a role in the behaviors the fundamentally politically–minded species known as homo sapiens. In the future, it will be important for researchers to continue recognizing and studying the ways in which both social and neural level constraints can inform psychological theorizing about political issues.

4. Behavior-Brain Relationships are Complex and Require Converging Evidence

In asking questions about the brain systems involved in political phenomena, what kinds of answers should we expect to receive? Consider the researcher who wants to identify the brain bases of political attitudes and finds that the amygdala is activated when participants express such attitudes. Should he conclude that the amygdala is the political attitude center of the brain?

This is clearly the wrong conclusion to reach for at least two important reasons. First, cognitive neuroscience research has shown that any given brain structure may participate in many kinds of behavior. In this case, the amygdala has been shown to participate in a wide range of affective and social behaviors (Adolphs, 1999; Breen, Caine, & Coltheart, 2000; Krakowski, 1997; McGaugh & Cahill, 1997), which means that interpreting the importance of amygdala activation in any single study depends in large part upon converging evidence from other studies that may have used different techniques, all of which inform understanding of the current data in question. The importance of converging evidence has been hit home many times in contemporary cognitive neuroscience (see Schacter, 1992; Ochsner & Kosslyn, 1999 for examples), and it is relevant both when designing studies and interpreting results. Hypotheses about what patterns of brain activation (for imaging or electrophysiological studies) or behavioral deficit (for neuropsychological studies) will tell us about the psychological processes involved in a given phenomena can only be generated with reference to current data concerning the functions for a given brain region. And our conclusions about expected or unexpected patterns of results similarly rely on the application of converging evidence to constrain theorizing.

Second, even seemingly simple forms of behavior and cognition depend on networks of interacting brain structures. Just as there is no single language "organ," in the brain, neither will there be a single political organ in the brain. Instead, studies are likely to reveal distributed patterns of activation across networks of brain structures, each of which may carry out a computation integral to the behavioral whole. Because different computations will be relevant depending on the particular task at hand, different networks of brain structures will be recruited to support task performance. This point is underscored by the review of memory and control systems above, which demonstrated that some structures, such as the amygdala or prefrontal cortex, seem to play important roles in many different social cognitive phenomena.

5. Properties of learning systems influence behavior and cognition

In many ways the brain can be said to have followed the strategy of divide and conquer: to the extent that different problems need fundamentally different solutions, different neural circuitry may have evolved to solve them (Sherry & Schacter, 1987). Understanding the properties of these systems can help us explain some properties of political and other social behaviors, as well as draw non-obvious connections with other related phenomena. One of the best examples of this kind of link comes from recent work on the neural systems for memory and learning.

Memory researchers make a distinction between the need to encode the regularities of experience that remain relatively constant over long periods of time and the need to encode specific episodes that may be important, even though they occur infrequently or only once. The former information is stable, statistical, and reliable whereas the latter type is episodic and flexible in its interpretation and use. When trying to design computational models that could encode, store, and retrieve both kinds of information, researchers found that it was not possible to design a single connectionist network to do both jobs (McCloskey & Cohen, 1989; French, 1999). It turned out that a system designed to extract experiential regularities needed to learn slowly so that no one experience had too much influence on the information stored within the network – a constraint that conflicted with the need to quickly encode all the features of single episode. The solution to the problem was found in the design of our brains: it appears that we have separate but interacting neural systems specialized for each kind of learning. McClelland, McNaughton, & O'Reilly (1995) argued that the cortex is structured to slowly learn regularities whereas the structure of the hippocampus makes it an ideal candidate for storing episodic records of experience. They built a computational model based on the neural architecture of these brain regions and showed that together these systems can underlie many commonly studied learning and memory phenomena.

The value of this model for understanding social-level political phenomena is that it can help explain why it is so difficult to change ingrained patterns of thinking, even though a single episode can teach us that long-held beliefs may be wrong. In the case of political biases against individuals who are members of a stereotypes group, for example, it would be very difficult to change knowledge representations of stereotyped groups that a cortical system that has slowly built up over time because the representations stored by that system can change only very slowly and with repeated exposures to relevant stimuli. Even though one might be able to remember a specific episode in which members of stereotyped groups did not act stereotypically, the cortical representations underlying the stereotype can not be modified rapidly. Substantial change of these representations would require many more counter-stereotypic experiences. Smith & DeCoster (1998) extended this logic to explain more generally why automatic responses in many social situations are so difficult to modify or resist. Additionally, many of the subcortical areas of the brain involved in social automaticity that comprise the X-system (Lieberman, 2000) have neural pathways linking them to motor areas of the brain without travelling through the prefrontal C-system, thereby bypassing deliberative control and behavioral inhibition.

6. Inferential Issues: From Neurons to Political Behavior

This article has focused on the possible roles of different neural structures in political attitudes and political sophistication. Political scientists may still be scratching their heads thinking that "this is all well and good, but can the measurement of the neural activity of ten individuals trapped inside the bore of an MRI magnet really tell us anything meaningful about how political behavior unfolds out in the real world?" We think the answer is yes, but not an unqualified yes. There are limitations and constraints on any measurement tool that is used and in psychology the trade-off often centers around experimental control and experimental realism. There is no question that cognitive neuroscience methods lean strongly towards experimental control and away from realism. This is why a cognitive neuroscience of political psychology would be foolish unless its results could be integrated with a pre-existing body of theory and data derived from a variety of methods. We echo what many have said before: multiple methods balance out the weaknesses of each. When the results from these different methods converge, progress is made.

That said, there are ways in which cognitive neuroscience methods can make direct contributions to the understanding of large-scale political phenomena. The small sample sizes of neuroimaging studies are not the problem that many believe them to be. With such samples, greater experimental control is needed to reduce statistical noise and produce effects large enough to be detected with a few degrees of freedom, but this is true of all neuroimaging research and great strides are being made to improve already successful designs. The physical constraints inside the scanner can be a real issue. The space is confining and cramped. However, after a little time in the scanner many participants become quite comfortable, sometimes to the point of nodding off. Real behavior is extremely limited in the scanner, but this is little different from a great deal of social-cognitive work in which participants are in front of a computer screen throughout the experimental session.

Perhaps the core concern here is whether anything can be done to cross-fertilize the scanner methods with observational and survey methods within a single study. While most fMRI studies compare how one or more brain regions respond in response to different tasks, there is another method that is being increasingly used to correlate complex behaviors outside of the scanner with measured neural responses in the scanner. Fazio and Williams (1986) conducted a social cognition study in which they used reaction times to measure their participants' cognitive accessibility for the presidential candidate they preferred. These accessibility estimates were then used to predict whether these participants went to the voting booth and voted on election day. In other words, cognitive indexes derived in the lab were used to predict real world behavior. Neuroimaging can be used in similar ways. For instance, two groundbreaking memory studies (Brewer, Zhao, Desmond, Glover, & Gabrieli 1998; Wagner et al., 1998) measured participants' neural activity while they were trying to commit various pieces of information to memory. Neural activity in prefrontal cortex and the medial temporal lobes during this encoding period was then able to predict successful recall of that information later after participants were no longer in the scanner. This same methodology could also be used to examine political behavior. For instance, the neural activity associated with expressing one's attitudes towards charity could be used to predict the participants' response to a charity soliciting outside the neuroimaging facility. Thus, even though certain behaviors cannot be brought into the scanner, political behaviors can still be analyzed in terms of their neurocognitive underpinnings.

Conclusion

In this paper, we have attempted to introduce some of the concepts, findings, and methods of cognitive neuroscience in hopes of persuading readers that cognitive neuroscience has something of value to offer political scientists. While cognitive neuroscience does provide new sources of information, it is no more a royal road to truth than self-reports or reaction time measures. Scientific truth is best approximated when a multitude of relevant tools are brought to bear on a problem. Hopefully, in the coming years, political scientists and cognitive neuroscientists will begin conversations and collaborations that will move us in that direction.

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[1] We want to be clear from the start that this model is just that, a model. We hope that it is a useful starting point for organizing many disparate findings from different levels of analysis that will facilitate communication between researhers based at these different levels. In our attempt to organize all of this information we have intentionally simplified extremely complex neurocognitive interactions. For instance, we have characterized the prefrontal cortex as being part of the C-system, however, at least one part of the prefrontal cortex (orbitofrontal cortex) is not easily classified into either the X- or C-system. In some parts of the model, we have also tried to make connections where none existed across different literatures. While we think this is critical to promoting interdisciplinary collaborations, we assume that parts of the model will require revision as new data are generated.