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The nature of conservatism and
liberalism:
A cognitive neuroscience perspective

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Abstract

In this essay, the author explores the nature of (1) conservatism and (2) liberalism, through a cognitive neuroscience perspective. Traditionally, political behavior and ideological reasoning have been understood in terms of social forces. Recently however, scholars have begun to approach political psychology through a biological perspective, which might add an important insight to the subject. Here, the author presents a collection of findings regarding the psychological and neurocognitive differences between conservatives and liberals. Conservatives appear to have increased activation in the amygdala in response to threat and increased gray matter volume within the right amygdala and left insula. Liberals on the other hand show increased activation in the anterior cingulate cortex (ACC) when cognitive control is required as well as increased gray matter volume. According to the well-known model of political ideology as motivated social cognition, motivations to reduce uncertainty and threat are positively correlated with conservatism and negatively correlated with liberalism. This model is consistent with the findings which suggest that conservatives recruit the amygdala more in response to threat, while liberals recruit the ACC in response to cognitive control. Since applying cognitive neuroscience to political ideology is in its early stages, the conclusions in this essay should be considered as tentative.

Keywords: Conservatism, liberalism, amygdala, ACC, Political ideology as motivated social cognition, threat, uncertainty, the chicken and the egg problem

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Introduction

Is it possible for cognitive neuroscience to help explain why individuals hold different political ideologies? If so, what conclusions are possible to legitimately draw? Disparities in what political ideology and party we choose to affiliate with are very likely the reason for much division and conflict between people. Labeling parties and ideologies distinct from our own as unrighteous and morally objectionable is common. Consequently, could insights about fundamental differences in individuals' basic neurocognitive functioning, help us better understand our political opponents' point of view, rather than completely denouncing them? This might be the case. In fact, evidence suggests that scientific curiosity counteracts politically biased information processing (Kahan, Landrum, Carpenter, Helft, & Jamieson, 2016)

Political ideology has almost exclusively been understood in terms of social forces. Although social processes might well play a significant role, approaching psychological phenomena only through a sociological perspective could arguably misrepresent reality (Hibbing & Smith, 2007). Consequently, a growing interest in incorporating cognitive neuroscience to better understand political behavior has emerged (Jost, Nam, Amodio, & Van Bavel, 2014). To further acknowledge biology as a valuable perspective on this subject, this essay will aim to examine the neural correlates and biological aspects of key characteristics that are associated with (A) conservatives and (B) liberals. Interpreting political orientation through a cognitive neuroscience perspective might help us increase our understanding of the biological underpinnings of political ideology.

As will be presented in this essay, there is evidence suggesting considerable discrepancies between conservatives and liberals in neurocognitive functioning. These discrepancies might even underlie many of the observable psychological and trait differences (Jost et al., 2014). Jost et al. (2007) coined the model of ideology as motivated social cognition, which states that a

prevalent need to handle threat and uncertainty is positively related to conservatism but negatively related to liberalism. According to the author of this essay, this is consistent with an increased amygdala volume (Kanai, Feilden, Firth, & Rees, 2011) and functional activation in conservatives (Oxley et al., 2008; Jost et al., 2014) and an increased ACC volume (Kanai et al., 2011) and functional activation in liberals (Jost & Amodio, 2012). The amygdala is involved in multiple functions but is characterized by its important role in emotion and threat processing. (Davis, 2006) The ACC in turn, is hypothesized to be involved in cognitive functions such as cognitive control and conflict monitoring (Jost & Amodio, 2012). Both these two brain structures are integral for normal functioning. Considering that some individuals might recruit one area more than the other, this might create differences in behavioral outcomes. In a larger context, perhaps, this enables a societal balance through which it creates diversity in personalities and ideas. Political neuroscience is however still in its early stage and the amount of studies examining the neural correlates of conservatism and liberalism is relatively small. Caution is therefore needed when drawing conclusions.

There will be limitations regarding which ideologies will be examined. As earlier noted, this essay will focus on conventional conservatism and liberalism. Therefore, ideologies that some might argue are interrelated with conservatism and liberalism, such as: fascism, national-socialism, socialism and communism, will not be considered.

In the second section of this essay, a background on the current topic will be given. In the third section, there will be an exposition of the key psychological characteristics and tendencies that have been subject to most examination in conservatives and liberals. In the fourth section, an investigation will be conducted on the neural aspects that are associated with those psychological characteristics and tendencies. The fifth section presents findings on the role of genetics in political orientation. In the sixth section, issues regarding using neuroscience on social

phenomena will be presented. In the seventh section, much of what has previously been presented, will be subject to a general discussion.

Background

What is political ideology? Blattberg (2001) describes it as a set of abstract beliefs which are held by individuals and groups. A more elaborate description of the term suggests that political ideology is an interlocking set of moral and political attitudes, which encompasses motivational, cognitive and affective components (Jost, 2006). This description suggests that political ideology entails various aspects of human psychological functioning (Jost, 2006). Political ideology has also been hypothesized to help explain social, economic and political realities. In other words, it can be considered as an aid to guide oneself on how to relate to different policies and social norms and moral outlooks. (Jost, 2006). Some people might not consciously or fully think of themselves as ideological. However, given the fact that ideology is entirely related to an individual's basic psychological functioning, it is proposed that it is indeed an everyday element in people's lives (Jost, 2006).

Ideological preferences are typically not seen as something that could be explained through biology (Hibbing & Smith, 2007). Many political scientists seem to be convinced that only environmental forces shape political attitudes. From their standpoint, ideological preferences are driven by campaign messages, conversations at work, peculiar experiences and parental socialization (Hibbing & Smith, 2007). Hibbing & Smith (2007) speculate that a possible explanation is that mass-politics seems so uniquely human and sophisticated, that scholars conclude that it transcends biology. Another speculation as to why political science traditionally does not incorporate biology into its research is the fear of many scholars in political science and the social sciences to acknowledge innate differences in humans (Hibbing & Smith, 2007).

Because of the unwillingness to consider biology in the research of political behavior, the former president of the American Sociological Association made a plea for the discipline to consider biological concepts more seriously (Hibbing & Smith, 2007).

Despite the uniqueness of political behavior, it does not mean that the ties to biology are different from the ties of biology with personal and social mechanisms (Hibbing & Smith, 2007). As noted earlier, ideology is significantly predicted by core psychological tendencies, such as how one relates to different emotions (e.g. threat, uncertainty) (Jost, 2006) and according to Jost et al. (2014), the most common view is that psychological and physiological characteristics, including personality, are heritable, stable and difficult to change. Furthermore, studies have found genes to play an important role in determining political attitudes and political ideology (Alford, Funk, & Hibbing, 2005) suggesting that political ideologies like conservatism and liberalism could include a heritability component (Fowler & Dawes, 2008; Alford et al., 2005). However, it is important to stress that this is only one of many contributing factors to an individual's political orientation (Jost et al., 2014).

Research examining political behavior and its relationship to neural functions have relatively recently begun to examine the matter (Jost et al., 2014). This new interest in integrating neuroscientific methods to examine the relationship between neural processes and political behavior, has led to the emergence of a field referred to by Jost et al. 2014 as political neuroscience. The areas that have been subject to most examination are (1) Partisan bias and motivated political cognition. This area is concerned to examine how political information processing is prone to a host of group-serving, self-serving and system- serving biases, which together encompasses what is referred to as partisan bias. It is known that motivational factors such as partisan goals, distort reasoning and judgement (Jost et al., 2014). (2) Racial prejudice (3) the dimensional structure of political attitudes and (4) the nature of ideological differences within

the left-right spectrum (Jost et al., 2014). Research examining the nature of conservatism (right) and liberalism (left), suggests that anatomical and functional variations in people's brains may underlie differences in ideological preferences (Jost et al., 2014). Some researchers have therefore assigned neurocognitive (biological) functioning a role in the shaping of political ideology (Jost et al., 2014). However, they do point out that neurocognitive structure and functioning is most certainly interrelated with social and psychological processes that unfold over time, which both reflect and induce the expression of political behavior (Jost et al., 2014). The connection between neurocognitive and psychological functioning and political outcomes should therefore be considered bidirectional, where both social forces and neurocognitive mechanisms interact with each other (Jost et al., 2014).

Based on the assumption that neurocognitive functioning plays a considerable role in political ideology, there are currently several studies examining the neural correlates of various aspects of political ideology (Jost et al., 2014). The application of neuroscience to explain political behavior, however, is not meant to completely replace existing theories on political ideology (Jost & Amodio, 2012). The goal is to incorporate assumptions from cognitive neuroscience to investigate the neurocognitive mechanisms that are related to political thinking and behavior (Jost & Amodio, 2012), thus adding a valuable component to the development of new theoretical perspectives regarding political behavior (Hibbing, Smith, & Alford, 2014).

Up until the current state, the most common methods used in political neuroscience have mostly been functional magnetic resonance imaging (fMRI) and electroencephalography (EEG). Whereas the former method offers a high spatial resolution and therefore a good capacity to represent neural activity in different brain regions, the latter provides a high temporal resolution enabling a useful measure of the time course related to specific cognitive processes (Jost et al., 2014). However, there are imperfections to consider when using the methods that have been

mentioned. fMRI lacks the temporal resolution it could very much benefit from, whereas EEG lacks the spatial resolution (Jost et al., 2014).

As earlier noted, the two political ideologies that will be focused on in this paper, which have also been subject to most investigation in research, are (1) Conservatism and (2) Liberalism. Research within political science and psychology has consistently found significant differences in cognitive styles and motivational profiles between conservatives and liberals (Amodio, Jost, Master, & Yee, 2007b; Kanai et al., 2011). The two core dimensions that typically separate a liberal outlook from a conservative, proposed by Jost, Glaser, Kruglanski & Sulloway (2003) are; (1) advocating for social change versus resisting social change, and (2) accepting inequality as opposed to rejecting inequality. In this case, the definition of inequality according to Jost et al. 2003, are social, economic, and political inequality, as reflected by policies such as economical redistribution. When it comes to social changes, conservatives' opposition is often in the short term, but might change towards acceptance with time, as they become part of the status quo. Depending on the issue or topic, the timeframe seems to differ (J.T Jost, personal communication, 20 May, 2017). A study by Graham, Haidt & Nosek (2009), examined whether conservatives and liberals rely on different sets of moral foundations. The results suggested that liberals were generally more concerned with a morality based on harm/care and fairness/reciprocity (social and economic equality) whereas conservatives showed a special concern for authority/respect and purity/sanctity (favorable towards hierarchy and morals valuing physical cleanliness). Furthermore, in a study examining values of liberals and conservatives, liberalism was positively associated with agreeableness and conservatism was positively associated with conscientiousness (Hirsh, DeYoung, Xu, & Peterson, 2010) Other psychological differences between conservatives and liberals, which have been found in several behavioral studies, are in addition more specific (Jost et al., 2014). Some examples are disparities in

decision-making, conflict monitoring (Jost & Amodio, 2012; Jost et al., 2014), disgust sensitivity (Inbar, Pizarro, & Bloom, 2009; Smith, Oxley, Hibbing, Alford, & Hibbing, 2011) and sensitivity to threatening stimuli (Vigil, 2010; Jost, Hennes, & Lavine, 2013). Furthermore, evidence suggests that holding a conservative or liberal orientation is evident early in childhood and rather stable across a lifetime (Alford et al., 2005). In one longitudinal study, pre-school children who were characterized as either exhibiting conservative or liberal tendencies, held at the age of 23 years, a political view congruent with their childhood tendencies, (Block & Block, 2006). However, there is evidence supporting the notion that an individual's political attitudes may shift when being presented by different cues, such as reminders of physical cleanliness. This is remarkable as it suggests to a certain extent that a person's political attitudes are subject to change in response to different circumstances (Helzer & Pizarro, 2011).

Functional and anatomical differences in the brains between liberals and conservatives have been found, and could possibly play a role in many of the psychological differences between the followers of the two different ideologies that have been brought up in this background (Jost et al., 2014). In a study by Kanai et al. (2011), holding typical liberal views was correlated with increased gray matter in the anterior cingulate cortex (ACC). In another study examining task related neural activity, following conflict related tasks, greater activity in (ACC) was seen in liberals (Amodio et al., 2007b). Holding predominantly conservative views is associated with larger volume of gray matter in the amygdala (Kanai et al., 2011). Further, conservatives show a larger skin conductance response (SCR) and defensive startle reflex to aversive stimuli (Oxley et al., 2008). Both responses are thought to reflect input from the amygdala (Davis, 2006). Lastly, in Kanai et al. (2011) evidence showed that gray matter volume in the left insula was positively correlated with conservatism.

Psychological characteristics and their link to political ideology

Holding either conservative or liberal views have consistently been linked with specific characteristics. These include variables such as personality types (Carney, Jost, Gosling, & Potter, 2008), morality (Graham et al., 2009) epistemic and existential needs/motives, such as how one handles uncertainty and threat and individual differences (Carney et al., 2008). To get an overall grasp of what psychological characteristics are related to an ideological orientation, Jost et al. (2003) suggest that it is important to hold a multi-dimensional approach, and include aspects that tie together both social and cognitive motives to political ideologies. These include: differences in personality, aspects stressing the satisfaction of epistemic and existential needs, as well as theories on the rationalization of social systems, such as traditionalism versus progressivism (Jost et al., 2003). One reason to why this multidimensional approach is essential is because it includes situational as well as dispositional variables that is linked to ideology, and not only individual differences and variations in personality (Jost et al., 2003).

Key characteristics in conservatives and liberals

Key characteristics associated with conservatives are various and there is a wide array of studies that have assessed these (Jost et al., 2014). Some general examples are: Protective of tradition, maintenance of the status quo and sensitivity to uncertainty, threat and disgust (Jost et al., 2014)

Several key characteristics have been associated with liberals (Jost et al., 2014). Some of these include: Openness to new experiences, cognitive complexity, egalitarianism and tolerance of uncertainty (Jost et al., 2014).

In a broader sense, the core dimensions most commonly emphasized in liberals are: (a) advocating for social change and (b) rejecting inequality (Jost & Amodio, 2012). In conservatives

on the other hand, the core dimensions are: (a) Resisting social change and (b) accepting inequality. Preferences within conservatives and liberals with respect to the two core dimensions, are thought to stem from very fundamental psychological alignments toward uncertainty, conformity and threat in (Jost & Amodio, 2012) These assumptions are organized according to a model referred to as the model of political ideology as motivated social cognition (Jost & Amodio, 2012).

Disgust

Disgust in conservatives

Disgust is regarded as one of our most primitive and basic emotions (Smith et al., 2011), induced by smells, sounds, sights and words (Inbar et al., 2009) Not so surprisingly then, disgust is proposed to be connected to the development of moral attitudes in many different cultures (Inbar et al., 2009) and is intimately involved in shaping perceptions of specific groups and acts (Rozin, Haidt, & McCauley, 2008). Furthermore, purity is often recognized as an important moral virtue. Individuals that are specially concerned about purity are more inclined to avoid phenomena that elicit disgust (Inbar et al., 2009). Conservatives are consistently associated with heightened disgust sensitivity (Inbar et al., 2009; Smith et al., 2011; Helzer & Pizarro, 2011), proneness to interpersonal disgust (Hodson & Costello, 2007) and the recognition of purity as a key moral virtue (Graham et al., 2009). One way disgust sensitivity has been examined is by measuring physiological responses to presented stimuli that elicit disgust. In these trials, individuals holding conservative standpoints have showed a heightened physiological response to disgust-eliciting stimuli (Smith et al., 2011).

Disgust in liberals

Liberals show a different response pattern to disgust eliciting cues, expressing less sentiments of disgust (Inbar et al., 2009; Oxley et al., 2008). In contrast to conservatives, liberals do not consider purity a moral virtue (Haidt & Graham, 2007). Generally, to liberals, disgust is not a factor to determine whether a practice or behavior is regarded as morally correct. Instead what determines what is right is whether the behaviors and practices harm or infringes on the rights of another person (Haidt, Koller, & Dias, 1993). Furthermore, liberals have been linked to being more favorable towards sensation-seeking and openness (Jost, Nosek, & Gosling, 2008) in which both are related to disgust insensitivity (Inbar et al., 2009).

Contrasting conservatives and liberals on disgust

It is very likely that there exist differences regarding attitudes on purity and disgust between liberals and conservatives, where conservatives generally are more sensitive to disgust. In two studies however presented, the researchers noted that participants' individual preferences could shift. When subjects were presented to reminders of cleanliness/physical purity, in both a public and laboratory set, participants shifted attitudes toward the conservative end of the political spectrum (Helzer & Pizarro, 2011). The researchers concluded that (1) there is a deep link between psychical purity and moral judgement and (2) manipulations of purity has the power to impact general political attitudes despite them being considered stable (Helzer & Pizarro, 2011). This phenomenon will be further touched upon in the discussion.

Evidence from studies however suggest a general pattern in which individuals with special concerns for disgust and purity, are more likely to be conservatives than liberals and hold typical conservative attitudes (Inbar et al., 2009).

Social hierarchy

Social hierarchy in conservatives

A theory named Social Dominance Theory, states that human societies try to minimize group conflict by adopting belief systems that legitimize the domination of their group over others (Van Hiel & Van Mervielde, 2002; Matthews, Levin, & Sidanius, 2009; Pratto, 1999). Moreover, according to this theory, individuals who score high on social dominance orientation (SDO) are more favorable towards hierarchy enhancing ideologies and policies (Van Hiel & Van Mervielde, 2002). Furthermore, holding a high SDO is associated with showing support to punitive policies and military programs (Van Hiel & Van Mervielde, 2002). In a study examining the relationship between SDO and various forms of conservative beliefs and political preferences, Van Hiel & Van Mervielde (2002) used different scales where subjects reported their views, to measure SDO and conservative beliefs. The researchers found that SDO was strongly correlated with conservatism ($r = .71, P < 0.001$). Furthermore, there are also data on self-reported attitudinal correlates to conservatives within the sphere of hierarchy (Jost et al., 2008). Conservatives were on average found to be more favorable toward big corporations, the American flag and most Americans (Jost et al., 2008). It is important to note however that these assumptions are based on average scores and thus exceptions are expected.

Social hierarchy in liberals

In contrast to conservatives, liberals possess significantly more egalitarian attitudes (Cunningham, Nezlek, & Banaji, 2004; Nosek et al., 2007). These findings are consistent with the notion of rejecting inequality being a core dimension in liberalism (Jost & Amodio, 2012). Liberals place higher value on reaching social and economic equality and policies concerning equal rights legislations and welfare, are especially important to liberals, as they are means to redistribute power and resources and thus increasing equality (Bobio & Cameron, 1996). Furthermore, data on self-reported attitudes show that liberals are more favorable towards

remedying social injustices, gay unions, feminism and affirmative action (Jost & Amodio, 2012).

Lastly, in four studies that examined what morals are most important to liberals, researchers found that a morality concerned with fairness was a prime concern (Graham et al., 2009).

Contrasting conservatives and liberals on social hierarchy

It is possible that conservatives are generally more favorable towards social hierarchies. In a concrete way, this is displayed through values and policies that favor one group over another, such as opposition to redistribution of financial funds and traditional gender roles (Jost & Amodio, 2012). This is in direct contrast to liberals, who support policies for distribution of resources and pro equality-based attitudes such as feminism (Jost & Amodio, 2012).

Threat

Threat sensitiveness in conservatives

Responding to environmental threats in an appropriate manner is vital for long-term survival (Oxley et al., 2008). Even though all people show a similar physiological response pattern to cues of threat, the way we perceive threat and how strongly we experience it, varies widely between individuals (Oxley et al., 2008). To investigate whether responses to threat are related to political orientation, a study was conducted measuring physiological responses to threatening images and sudden noises (Oxley et al., 2008). First participants were asked about their preferences on various policy issues. In another session, the physiological responses to threatening images in conservatives and liberals were measured. The researchers observed that individuals who held conservative policy preferences exhibited heightened skin conductance responses (SCR) which is an index of arousal to arousing stimuli (Oxley et al., 2008). Moreover, in a review that examined the relationship between conservatism and various traits based on research from 5 different countries involving over 20 tests, suggested that fear and threat was

positively and significantly correlated with political conservatism ($r=.30$, $p < 0.0001$). The data were collected through surveys and involved different scales measuring threat sensitivity and political conservatism (Jost et al., 2003).

Threat sensitiveness in liberals

According to Jost & Amodio (2012) a wide array of research suggests that lower psychological needs to manage uncertainty and threat is related to liberalism. In the study by Oxley et al. (2008), where they measured physiological responses to threatening stimuli, individuals with lower physical sensitivities were more likely to support liberal attitudes (Oxley et al., 2008). Evidence point towards the notion that instead of looking out for threats, liberals place a higher value on exploring what is unknown (Jost et al., 2008) which is quite the opposite of being wary.

Contrasting conservatives and liberals on threat sensitivity

Conservatives seem to generally be more sensitive to cues of threat than liberals (Jost et al., 2003). One could speculate that this will be reflected in the political policies that conservatives favor. The study above, by Oxley et al. (2008) is interesting. Therefore, it would be valuable to replicate the study as to give further credibility to the results or potentially dispute them. At this current time, the author of this essay has not found any replications.

In-group and out-group attitudes

In-group and out-group attitudes in conservatives

The inclination to favor members of one's own in-group over members of an out-group is well established and is referred to as in-group favoritism (Everett, Faber, & Crockett, 2015) This strong tendency to seek out and identify certain groups, is thought to facilitate cooperation with the in-group and thus, some scholars speculate that it had clear evolutionary advantages (Everett

et al., 2015) Although these needs are universal, some studies suggest that the degree of in-group preferences expressed, might vary (Graham et al., 2009). Conservatives especially have been shown to express heightened concerns for in-group loyalty, even to the extent in which it is considered an important moral virtue (Graham et al., 2009). Furthermore, conservatism is traditionally considered to be invariably associated with nationalism and patriotism, in which both are related to heightened preferences for in-groups (Takeuchi et al., 2016). A priority for what is considered stable, familiar and predictable might underlie the appreciation of in-group loyalty (Graham et al., 2009) which are all preferences associated with conservatives (Graham et al., 2009).

In-group and out-group attitudes in liberals

In contrast to conservatives, liberals are on average open to what is unfamiliar both in their social lives and in politics (Graham et al., 2009). A review by Nosek et al. (2007), examined a large web datasets of implicit and explicit measures regarding social identity and social dominance. To measure the implicit responses, an implicit association test (IAT) was conducted. The explicit responses, was measured through a questionnaire where attitudes were self-reported. The researchers were specifically interested in examining the subjects' stand towards other groups such as the opposite gender, races and sexuality. The subjects themselves were categorized by gender, ethnicity and political preferences. The review provided evidence that suggested that liberals show substantially less implicit group preferences relative to individuals with more right wing views. Evidence for explicit attitudes also suggested that liberals showed lesser in- group preferences and was more robust than for implicit attitudes (Nosek et al., 2007) However, it was in fact noted that liberal did also show some general group preferences, but more weakly than conservatives (Nosek et al., 2007).

Contrasting conservatives and liberals on in-group and out-group attitudes

In-group loyalty to conservatives is not only a preference but it also seems to be considered as a core moral virtue. This is undeniably distinct from the evidence which suggests that liberals show less in-group preferences as well as being more open to what is unfamiliar. It therefore seems plausible to suggest that conservatives are on average more inclined to prefer in-groups, than do liberals.

Cognitive styles

Cognitive tendencies in conservatives

Within political science and psychology, it has been noted that conservatives on average exhibit more persistent and structured cognitive styles and are less prone to cognitive flexibility (Amodio et al., 2007b). Conservatives also display a heightened intolerance to ambiguity (Jost et al., 2003), high need for closure (Hibbing et al., 2014), a desire for order/stability, changes to circumstances in a slow pace and adherence to preexisting norms (Jost et al., 2003) and this being consistent with the assumption that one core dimension within conservatism is to reject social change (Jost & Amodio, 2012). Furthermore, across dozens of studies, as indicated by higher scores on psychological measures, conservatives approach decision-making, needs for order and closure in a more structured way. More specifically, this reflects an increased need for structure and predictability. (Amodio et al., 2007b). One example is that conservatives, relative to liberals show less neurocognitive sensitivity as measured through less activity in the ACC in response to go-no go tasks which measure the processes of conflict monitoring. This was hypothesized to be the underlying mechanism to why conservatives scored lower than liberals in the task (Amodio et al., 2007b).

Cognitive tendencies in liberals

Liberals report a higher tolerance of ambiguity, cognitive complexity and openness to new experiences (Amodio et al., 2007b). In comparison to conservatives, liberals are better at conflict monitoring as indicated by better results at the go-no-go task where one must regulate one's responses to conflicting information (Jost et al., 2014). When asked to perform on tasks measuring the processes of conflict monitoring, liberals show higher neurocognitive sensitivity, as indicated by increased neural activity in the anterior cingulate cortex (Amodio et al., 2007b). Furthermore, in a study by Jost et al. (2008) liberals showed implicit preferences for flexibility over stability and progress over tradition. These results are in alignment with the notion that a core dimension in liberalism is advocating for social change (Jost & Amodio, 2012).

Contrasting cognitive tendencies in conservatives and liberals

In general conservatives seem to value structure, stability and consistency and a more fixed cognitive style when approaching different situations. This is consistent with the typical and traditional definition of conservatism which has been around for a long time: a resistance to change and a tendency to favor safe, traditional and conventional forms of behavior (Stacey, 1977). Liberals on the other hand, not only explicitly favor progress and novelty but they measurably respond with much more sensitivity to situations that require cognitive flexibility (Amodio et al., 2007b). Considering that cautiousness in the face of change and a desire for order/stability are pervasive in conservatives, perhaps this mediates the other conservative tendencies, such as threat sensitivity. However, it might well be the other way around.

Personality traits

Personality traits linked to conservatives

Across several studies, conservatives have been linked to specific personality dispositions (Carney et al., 2008). In one study, it was found that conservatives generally were orderly,

conventional and better organized (Carney et al., 2008). The researchers proposed that these characteristics are captured by conscientiousness which is one of the “big five” of personality traits and (Carney et al., 2008) conservatism has moreover been positively associated with conscientiousness in several studies (Hirsh et al., 2010; Jost, 2006; Gosling, Rentfrow, & Swann, 2003) The need for order and stability in conservatives could plausibly be reflected by the aspect of conscientiousness as typical personality trait in conservatives (Hirsh et al., 2010).

Personality traits linked to liberals

Liberals have been associated with agreeableness, which is also one of the “big five” (Hirsh et al., 2010). Moreover, liberal tendencies such as proclaiming communal goals, acceptance of out-groups and egalitarianism are related to agreeableness as a personality trait (Hirsh et al., 2010). Furthermore, liberals as opposed to conservatives, score high on the personality trait, Openness (Carney et al., 2008) which captures several tendencies that have been associated with liberalism, for example: being more open minded when pursuing creativity, novelty and diversity (Carney et al., 2008).

Contrasting conservatives and liberals on personality

So far, conservatives are generally more wary, sensitive to different aversive stimuli, conscientious, conventional, hierarchal and structured. In contrast, novelty seeking, cognitive flexibility, unconventionality and openness to experience constitutes much of the liberal tendencies. Thus, studies linking the conscientious personality trait to conservatism and the openness personality trait to liberalism, is consistent with many of the psychological and behavioral tendencies that has been covered in this paper.

Neural correlates in conservatism and liberalism

There is evidence indicating the existence of structural differences between conservatives and liberals in certain brain areas, as well as functional differences when responding to certain situations (Jost et al., 2014). In this chapter, neural aspects related to the psychological functions and tendencies that have been covered in conservatives and liberals will be presented.

Disgust in the conservative and liberal brain

The insula plays an integral role in the experience of several different types of disgust (Wicker et al., 2003; Chapman & Anderson, 2012). To explore if brain structure would show any correlation with political orientation, Kanai et al. (2011) conducted an exploratory analysis of the brain, in which the areas of interest were specifically the anterior cingulate cortex (ACC) and amygdala. The participants consisted of 90 healthy university students (mean age 23,5 years, 55 female) that were asked to specify their political orientation on a scale of (1) liberal (2) middle of the road (3) conservative (4) very conservative. They then had their brain scanned through an MRI. Among other findings (which will be covered in upcoming sections) researchers found that conservatism was significantly associated with larger gray matter volume in the left insula. This could possibly imply that disgust sensitivity in conservatives is mediated by increased insula volume. An elaboration on this will be available in the discussion

To test whether the obtained results were reliable, the researchers replicated the study by using an independent sample of 28 new subjects that were recruited from the same demographic group. The procedure was the same as in the previous experiment. The results from the replication showed statistically significant results, and thus replicated the former findings. Liberals on the other hand, did not show such any association of increased gray matter in the left insula.

Social hierarchy in the conservative and liberal brain

In a study by Chiao, Mathur, Harada, & Lipke (2009), researchers sought to examine the neural basis for social dominance hierarchy and egalitarianism, in which the former is significantly associated with conservatism and the latter with liberalism and empathic concerns. The researcher's hypothesis was that the degrees of preference for social hierarchy that participants would exhibit would vary as function of neural activity associated with empathy. More specifically, higher favorability towards social hierarchies would mean less activity in brain areas involved in processing empathy (ACC and left anterior Insula). During the fMRI scan, participants were shown pictures of individuals in either a painful or neutral situation and asked to indicate how much empathic concern they felt for a person in the target image using a four-point scale. After the scanning, participants completed a 24-item social dominance orientation scale, to estimate each participant's preference for social dominance hierarchy as well as the interpersonal reactivity index (IRI) scale to estimate each participant's dispositional empathy. The results showed that individuals who preferred social dominance hierarchy showed less response to pain in others within the left anterior insula (AI) and (ACC) as opposed to the participants who preferred more egalitarianism who had increased neural activity in those areas. Moreover, the AI and ACC are generally associated with aversion to inequity but also disdain for any type of group-level social inequality as well as empathy (Singer et al., 2006) Since the researchers took necessary measures to control for gender, age and sex in participants, they made sure that the modulation of fronto-insular neural responses to could not be explained by other characteristics than preference for social hierarchy and egalitarianism. In sum, the study found that individuals who preferred social hierarchy (e.g., political-economic conservatism) showed less neuro-affective sensitivity to others' concerns than those who favored more egalitarianism

and this was hypothesized to be mediated by neural activity in the AI and ACC (Chiao et al., 2009).

Threat in the conservative and liberal brain

Amygdala has consistently been shown to play an integral role when responding to threat (LeDoux, 2000). Kanai et al. (2011) examined the hypothesis that increased threat sensitivity in conservatives would be reflected in amygdala volume. The researchers employed a whole-brain analysis with an MRI, and found that increased gray matter volume in the right amygdala was significantly correlated with conservatism. Such a connection was however not apparent in liberals. As noted in an earlier section, Kanai and colleagues replicated the whole-brain analysis with 28 new participants. The results confirmed the former experiment in which increased Amygdala volume was significantly correlated with conservatism.

Furthermore, as noted before in this essay, Oxley et al. (2008) found that conservatives in comparison to liberals exhibited significantly higher autonomic arousal in response to threatening images. A heightened autonomic arousal is hypothesized to reflect increased activity in the amygdala (Davis, 2006) which furthers the assumption that the amygdala might be a mediating factor in threat sensitivity discrepancies between conservatives and liberals.

In-group and out-group in the conservative and liberal brain

Conservatives are especially concerned with in-group loyalty (Graham et al., 2009) as well as an increased preference for nationalism, and as earlier noted, also tightly linked to heightened in-group preferences (Takeuchi et al., 2016). In a review of the neural correlates of in-group bias, Molenberghs (2013), provided evidence that in-group favoritism is related to increased activation in medial prefrontal cortex (MPFC). Mitchell, Macrae, & Banaji (2006) investigated the neural underpinnings when judging in-groups and out-groups. They found that

conservatives showed greater activation of dorsomedial prefrontal cortex (DMPFC) in response to liberals, whereas liberals showed less activation in the DMPFC in response to conservatives. The fact that liberals showed less neurocognitive sensitivity when processing an out-group is consistent with the notion that liberals express less in-group preferences than conservatives (Nosek et al., 2007).

In a study by Lewis, Kanai, Bates, & Rees (2012) the researchers explored the possibility that “binding” and “individualizing” values of morality are associated with individual differences in regional brain volume. Earlier work by Graham et al. (2009) suggested that conservatives are generally more inclined to “binding” values in morality which encompasses special concerns for in-group loyalty and adherence to authority whereas liberals are more inclined to the “individualizing” values which entails special concerns for harm and care. The results of Lewis and colleagues study showed that individuals favoring the binding values were positively and significantly associated with bilateral subcallosal gyrus volume and a trend to significance for left anterior insula volume. The latter association showed however only a trend towards significance and thus the results should be interpreted with caution (Lewis et al., 2012) Individuals favoring the “individualizing” values, were significantly and positively associated with left dorsomedial Prefrontal cortex (dMPFC) volume and negatively associated with bilateral precunus volume. (Lewis et al., 2012).

One study found that the lateral prefrontal cortex (IPFC) plays a useful role when liberal minded participants attempt to implement egalitarian responses Amodio, Devine, & Harmon-Jones (2007a). After white subjects viewed pictures of multiracial faces, they received bogus feedback, indicating anti-black responses and consequently they felt guilt. They then had an opportunity to engage in prejudice-reducing behavior. This activity was reflected in greater IPFC activity. In sum, the researchers found that subjects who attempted to regulate prejudice

displayed increased activity in the left prefrontal cortex. The researchers proclaimed that this pattern of neural activity was in fact a predictor of the subject's behavioral intentions to reduce prejudice (Amodio et al., 2007a).

Cognitive styles in the conservative and liberal brain

The anterior cingulate cortex (ACC) is a brain region that has been assigned an important role in the self-regulatory process of conflict monitoring (Botvinick, Braver, Barch, Carter, & Cohen, 2001). Recent work has shown that differences in cognitive styles and specifically conflict monitoring between liberals and conservatives, might be reflected in both functional (Amodio et al., 2007b) and anatomical variations in the anterior cingulate cortex (ACC) (Kanai et al., 2011).

Conflict-monitoring is a cognitive mechanism for detecting when a habitual response tendency is mismatched with responses that is recruited in the current situation (Botvinick et al., 2001). One task that is used to measure conflict-monitoring, is called the Go-No-Go task. Participants are asked to respond to a stimulus that signals 'Go'. This is repeated until the 'Go' response become habitual. However, on a small number of the trials, a No-Go stimulus appears, which signals that one's usual response should be kept back. In a study published in the journal *Nature*, Amodio et al. (2007b) sought to explore the possibility that differences in conservative's and liberal's responsiveness to relatively complex and potentially conflicting information, would be reflected in different results in the Go- No-Go task, and potentially mediated by ACC activity. The researchers posed the hypothesis that liberalism as opposed to conservatism would be correlated with greater activity in the ACC in response to cognitive conflict. Electroencephalograms (EEG) were recorded from participants while they performed the Go-No-Go task. Two components of event related potentials (ERP) were

employed to point out conflict-related ACC activity. ERP measures voltage changes in the reflecting the firing of neurons in response to a certain psychological event. Further, the error-related negativity (ERN), peaks at 50 ms following an incorrect behavioral response and reflects conflict between the habitual tendency, in this case the 'go response' and an alternate response, in this case the inhibitory behavior in response to a No-Go signal. The researchers also examined the No-Go N2 component, which is thought to reflect conflict-monitoring activity, related to the ability to successfully inhibit the excessive Go-response on the No-Go trials. To assess the relationship between liberalism/conservatism and neurocognitive properties researchers used two-tailed correlational analysis. Results showed that political orientation was highly correlated with ERN amplitudes and No-Go N2 amplitudes. More specifically, liberalism (as opposed to conservatism), was correlated with significantly greater conflict related neural activity on No-Go trials (when response inhibition was required). In addition, stronger liberalism was correlated with better accuracy on the Go-No Go trials. A partial correlation analysis was employed to assess whether the relation between political orientation and ERN would remain, after covarying behavioral accuracy. The results from this suggested that the relationship political orientation and the ERN remained strong. The researchers' conclusion was that political orientation reflects individual differences within the mechanisms that are related to cognitive control and self-regulatory processes. More specifically, greater conservatism as opposed to liberalism was negatively correlated with neurocognitive sensitivity in the face of conflicting responses. This study, was the first to connect individual differences in political ideology to a fundamental neurocognitive mechanism involved in self-regulation (Amodio et al., 2007b).

Since then, more studies have found similar results. In a study by Weissflog, Choma, Dywan, Van Noordt, & Segalowitz (2013) the researchers found that self-reported liberalism was correlated with greater ACC activity on No-Go trials. In another study linked to

self-regulation, researchers examined the role of cognitive mechanisms and neural activity in relation to individual differences in regulation of intergroup bias. The experimenters found that the variability in intergroup bias between liberal minded and conservative minded, was attributed to variations in conflict monitoring and increased activation in the ACC (Amodio, Devine, & Harmon-Jones, 2008).

Besides the findings that suggests functional differences in ACC expression between liberals and conservatives, there is also evidence on anatomical variations (Jost et al., 2014). Drawing on earlier findings which have connected liberals to an increased sensitivity in the face of cognitive complexity, Kanai et al. (2011) were specifically interested in examining any potential anatomical variations within the ACC in conservatives and liberals. The researchers' hypothesis was confirmed by which increased gray matter volume in the ACC was significantly associated with liberalism. As noted earlier regarding Kanai and colleagues study, a replication of the study was made, in which the results from the former study were confirmed (Kanai et al., 2011).

Building on the revealed differences in conservatives and liberals when engaging in certain cognitive tasks as well as differences in reacting to threat, Schreiber et al. (2013) sought to explore potential differences in functional activity when performing a risk-taking task. Risk-taking, is defined as the inclination to select an action where there is a potential for a beneficial outcome but with the possibility of an unfavorable outcome (Schonberg, Fox, & Poldrack, 2011) and requires the ability to balance conflicting interests to obtain reward and avoid losses. It is also interrelated with the subjective appraisal of threat (Mogg, Mathews, & Weinman, 1989). Since physiological and neural differences between conservatives and liberals have been detected in response to threat and cognitive conflict, and in particular, differences within the amygdala and ACC, Schreiber et al. (2013) were interested in the neural underpinnings of specific risk-taking

and decision-making tasks. Since these are related to cognitive conflict and threat, risk-taking and decision-making is hypothesized to involve the amygdala and the ACC (Bechara, Damasio, &, Damasio, 2003), the researchers deemed it possible that their study would find some involvement of the amygdala and ACC. If evidence for this would to be found, the researcher reasoned that it would put further credibility to the assumption that there are certain brain areas that mediates cognitive discrepancies between conservatives and liberals (Schreiber et al., 2013).

The participants in the study completed a risk-taking decision making task while a BOLD-fMRI run was collected. The researchers examined spheres centered on areas in the insula, amygdala, ACC and entorhinal cortex, areas that have previously been related to differences in conservatives and liberals (Kanai et al., 2011). Consistent with Kanai and colleagues' findings, Schreiber et al. (2013) observed greater activation in the right amygdala for conservatives (Kanai et al., 2011) whereas in liberals, increased activity was seen in the left posterior insula (bordering the temporal-parietal junction), when making winning and risky decisions as opposed to winning and safe decisions. Despite the prediction that differences would be observed in the entorhinal cortex and ACC, no significant differences were found (Schreiber et al., 2013). Left posterior insula and amygdala, are hypothesized to often work together when processing risk and uncertainty (Sarinopoulos et al., 2009). In addition, it is important to note that the left posterior insula borders the temporal- parietal junction. This area has been conceptualized as essential for theory of mind. As indicated by a meta-analysis of hundreds of fMRI studies, the temporal-parietal junction has been shown to play an essential role to understand immediate action intentions in others (Van Overwalle, 2009).

Personality trait variations in the conservative and liberal brain

Empirical evidence supports the assumption that liberals score higher than conservatives on personality traits such as extroversion, agreeableness, openness and empathy (Newman-Norlund, Burch, & Becofsky, 2013). Personality traits incorporate both social and emotional abilities (Newman-Norlund et al., 2013) both of which are phenomena with ties to the human mirror neuron system (hMNS) (Rizzolatti & Craighero, 2004). Newman-Norlund et al. (2013) conducted a pilot study where they sought to examine potential differences within the hMNS in conservatives and liberals. Specifically, the researchers' hypothesis was that liberals would show greater resting state functional activity within the hMNS than self-reported conservatives. The researchers sought to isolate task-independent neural markers correlated with political party affiliation. To examine this, they used a fMRI where they measured resting state functional connectivity in the subjects while they rested with their eyes closed. This enabled the experiments specifically quantify the correlation between neural activation patterns in several different brain regions. The resting state functional connectivity provides information concerning the default strength of the linkage between specific brain regions. Moreover, it has been found to predict real life task performance/behavior (Newman-Norlund et al., 2013). Besides assessing participants' political orientation, empathy was assessed since it could potentially be a driving factor in any differences in pattern resting state functional connectivity. This was done using Interpersonal reactivity index (IRI). Consistent with the researchers' hypothesis, the results from the fMRI showed that core components of the hMNS had a greater connectivity in the sample of self-reported liberals than in the sample of self-reported conservatives. More specifically, resting state functional connectivity between the inferior frontal gyrus (IFG) and the angular gyrus (ANG) in both left and right hemispheres, was stronger in liberals. IFG is hypothesized to house mirror neurons, play a significant role in social perception (Keuken et al., 2011) and processing the concept of self as well as differentiating the self from other (Newman-Norlund et al., 2013).

ANG, on the other hand is thought to be recruited during sensory conflicts related to the sense of agency and body ownership (Tsakiris, Longo, & Haggard, 2010). The IFG-ANG connectivity observed in the liberals was faintly hypothesized in the study to be related to favorable processing of broad social connectedness, that is, less close relationships. (Newman-Norlund et al., 2013)

Further, the researchers, to their surprise, found data suggesting more robust resting-state functional connectivity in conservatives between the IFG and supramarginal gyrus (SMG) in the right hemisphere. It has been demonstrated in an earlier study that adopting a self-centered perspective as opposed to other-centered perspective, is correlated with greater recruitment of the SMG. Thus, the researchers hypothesized that IFG- SMG connectivity could reflect favorable processing of very close social relationships. The neural differences that were noted between conservatives and liberals, were not linked to any differences in empathy since there were no significant differences in empathy-scores between the two groups, as measured by the IRI.

Further, the researchers noted that most (7/9) of the significant differences in the study were located at the left hemisphere. Potentially, this reflects a certain relationship between resting-state functional connectivity in particularly the left hemisphere and political orientation (Newman-Norlund et al., 2013). In sum, this study explored the possibility of differences within the hMNS between self-reported conservatives and liberals and found evidence for such a difference.

However, the study only involved 24 participants, hence it is hard to claim that these results essentially hold for the general population (Newman-Norlund et al., 2013). Although caution should be taken when interpreting the results, they are however consistent with previous findings on social tendencies in conservatives and liberals (Newman-Norlund et al., 2013).

In an integrative review, Kennis, Rademaker, & Geuze, (2013) sought to explore the neural correlates of a revised model of Gray's reinforcement sensitivity theory of personality (RST). The original RST is a prominent and two dimensional neurobiological personality model,

in which impulsivity and anxiety were regarded as two major dimensions that can explain individual differences in approach and avoidance behavior (McNaughton & Gray, 2000). In the revised model however, reactivity and sensitivity of three different neurobiological networks in response to negative, positive or conflicting stimuli were suggested to account for individual differences in avoidance, approach and inhibition of behavior (Kennis et al., 2013). Three neural systems are proposed to work in combination to orchestrate human behavior in response to different stimuli. These are the behavioral approach system (BAS) which governs approach behaviors, fight flight freeze system (FFFS) governs reactivity to negative stimuli and behavioral inhibition system (BIS) which handles passive avoidance tasks/extinction tasks and regulates responses from BAS and FFFS (Kennis et al., 2013). Traits that are related with a sensitive BAS, are impulsivity, sensation seeking, experience seeking, novelty seeking and openness to experience (Kennis et al., 2013), many of which are prominent in liberals (Jost et al., 2008). In the review by Kennis et al. (2013) the researchers proposed that BAS related personality traits were consistently positively correlated with increased activity in ventral and dorsal striatum as well as ventral PFC in response to positive stimuli. Furthermore, in response to cognitive tasks and positive stimuli, BAS related personality traits were related with increased activation in the ACC and amygdala (Kennis et al., 2013).

Behavioral outcomes of BIS, include increased attention to threat and conscientiousness both of which are related to conservatism (Graham et al., 2009; Jost et al., 2003; Oxley et al., 2008). FFFS and BIS related personality traits are positively correlated with in the amygdala in response to negative stimuli (Kennis et al., 2013). In addition, FFFS and BIS were also correlated with decreased connectivity of the amygdala with the ACC, PFC and hippocampus (Kennis et al., 2013). These findings suggest that avoidance behaviors are correlated with interactions between these brain areas (Kennis et al., 2013).

Genetic findings

How legitimate is it to claim that differences psychological and neurocognitive differences between conservatives and liberals are innate rather than acquired? Existing research at its current state is not able to give any complete answers. (Hibbing et al., 2014). The dominant assumption however in many people and much of the scholars, is that political orientation are products of socialization, predominantly through parents and family (Hibbing et al., 2014). Yet, the effects of parental socialization on political ideology are rather weak (Niemi & Jennings, 1991). Genetic studies might add a valuable contribution to the nature or nurture debate (Hibbing et al., 2014). In 1986 a study using a standard twin design, a heritability estimate for political attitudes was found to be between 0.2 and 0.4 (Martin et al., 1986). More recent twin studies, confirm the possibility that political orientation might be heritable (Alford et al., 2005; Hatemi, et al., 2010; Smith et al., 2011). In one of these studies, Alford et al., 2005 compared different correlations of attitudes in a large sample of monozygotic and dizygotic twins. The results lead the researchers to conclude that genetics might play an important role in shaping political ideologies and attitudes. Furthermore, in a study conducted by Hatemi et al., (2011), researchers attempted to identify specific genes that involved in the genetic influences of political orientation. Utilizing a genome wide analysis of conservative and liberal attitudes from a sample of 13.000 respondents, DNA was collected in combination with a 50-item sociopolitical attitude-questionnaire. Four regions of interest were identified which contained genetic loci that have previously been shown to have a relationship with human social behavior and cognitive functioning. The most significant quantitative trait loci (QTL) accounted for 12.9%, of the total phenotypic variation on the Liberalism-Conservatism attitude factor, implying that the gene accounting for that QTL had a correlation with conservatism-liberalism at 0.36. The researchers noted however that larger estimates of QTL are typically biased upwards and therefore call for

caution and more studies on this topic (Hatemi et al., 2011). Taken together, findings on twin studies do suggest that political orientation could include a heritability component (Hibbing et al., 2014). However, the connection from genes to social behavior is complex and involves many contributing mechanisms. Multiple neurobiological processes, gene expressions and environmental contingencies will influence the results, which explains why genome wide analysis are rarely replicated, (Hatemi et al., 2011). Moreover, identifying particular genes that might relate to politics could to provide more insight. However, identifying the genetic pathways that lead to adherence to a specific ideology, is not an easy task (Hibbing et al., 2014). Lastly, the connection from genes to social behavior is complex and involves many contributing mechanisms. Multiple neurobiological processes, gene expressions and environmental contingencies will influence the results, which explains why genome wide analysis are rarely replicated (Hatemi et al., 2011).

Applying neuroscience to social phenomenon

Social and biological explanations, have traditionally been considered antagonistic or even incompatible. For instance, some in the neurosciences still have a hard time accepting social approaches to human behavior, whereas many social scientists argue that biology is irrelevant for understanding of societies and cultures (Cacioppo, Berntson, Sheridan, & McClintock, 2000). Advances in the natural and behavioral sciences however, have favored a shift where biology and social phenomenon are both considered important when explaining human behavior (Cacioppo et al., 2000) Technical and methodological advances have made it possible for biological measures of ongoing behaviors. Conversely, social methods for studying biological function are also being applied. But even though we can assess associations between biological and social events, that

itself does not prove that these associations are causally linked, nor does it say much about the mechanisms involved (Cacioppo et al., 2000).

Furthermore, neurocognitive studies might suggest correlations between behaviors and certain neural properties. But how can one be certain that brain function and structure caused a certain behavior, in this case, the acquisition of a political ideology, rather than the other way around? Despite that physiological characteristics are considered stable, heritable and difficult to change, there is evidence that the brain can change in response to experience and repetition (Jost et al., 2014) The fact that it goes both ways and that it is difficult knowing which caused what, it is referred to as the chicken and the egg problem (Jost et al., 2014). Examples of when social text can alter physical expression are various. For instance, in rhesus monkeys, early nurturance can modify genetic predisposition cortex (Cacioppo et al., 2000). Studies on rat pups, suggest that tactile deprivation reduces the amount of glucocorticoid receptor binding sites in the hippocampus and frontal cortex (Cacioppo et al., 2000). In humans, compassion training has been shown to have long term alterations brain function, specifically in the ACC and anterior insula-brain areas that are involved in affective empathy (Jost et al., 2014). Another intriguing example, is that men who had 4 years of training to become taxi drivers in London, showed structural changes, in which their hippocampus had increased gray matter volume (Jost et al., 2014). Conversely, social processes can strongly be affected by variations and alterations in brain function (Jost et al., 2014). Brain injuries for instance, can strongly affect behavior. One well-known case is the one of Phineas Gage. In an accident, a pole penetrated his skull and damaged the ventromedial parts of the PFC in both hemispheres severely. Before the injury, Gage was considered energetic, sensible and persistent. After the injury, he became impulsive, impatient and had sever anger and rage problems (Jost et al., 2014). Another example, illustrates what happens to individuals who lose their amygdala and associated parts of the temporal cortex.

Known as the Kluver-Bucy syndrome, these individuals show a loss of fear responses, increased and inappropriate sexual activity (Cacioppo et al., 2000). These examples show everyday social behaviors, have a strong basis in neurophysiological processes (Cacioppo et al., 2000).

Much of the evidence suggests that both biology and social context are important to consider. Rather than antagonistic they are complementary (Cacioppo et al., 2000) According to Jost and colleagues, differences in neurocognitive functioning are interconnected with various sociological and psychological processes that develop over time, and consequently reflect and give rise to different political behaviors (Jost et al., 2014). It is therefore of outmost importance that the theoretical framework in political neuroscience, is based on a bidirectional connection between physiology and psychology and longitudinal studies (Jost et al., 2014).

Another issue in political neuroscience is the natural limitation of brain-mapping. Namely, one cannot be certain that changes in brain activity are a direct and invariant measure of what is being investigated. Nor, is it certain that what we think is a function of a specific brain area, is completely true (Jost et al., 2014). It is not possible to avoid these problems all together, which means that interpreting brain activity should be made with great caution as well as treating current findings as tentative and subject to revision (Jost et al., 2014).

Discussion

In this discussion, the aim will be to extend the scope from earlier sections. Everything that has been presented up to this point will be available for discussion. In cognitive neuroscience, where linking psychological and cognitive functions to the brain is central, different brain mapping techniques are essential and enable us to gain meaningful insights about the mind-brain connection. Similarly, in what some refers to as political neuroscience, the aim is specifically to deepen the understanding on political cognition and ideological activity, through a

cognitive neuroscience approach. In this essay, the main aim was to explore the neural underpinnings of the key characteristics associated with (1) conservatism and (2) liberalism. From now on, the focus will lie on discussing the following: (1) what do the neural studies on ideology and political behavior mean and what questions do they pose? (2) What conclusions can be legitimately drawn?

In the earlier section about disgust in the conservative and liberal brain, Kanai et al. (2011) found that the right insula was larger in conservatives than in liberals. The insula in turn, is thought to be involved in processing disgust. As mentioned in this paper, conservatives have been found to be more sensitive to disgust eliciting stimuli. Thus, the evidence suggesting a larger insula in conservatives is consistent with the notion that conservatives are generally more susceptible to feelings of disgust relative to liberals. It is important to remember however that these findings apply to a general level. Thus, there is no reason to claim that every person identifying as a conservative is invariably going to have a larger insula than a liberal, or be more sensitive to disgust. In any case, the findings do evoke some interesting thoughts. Are structural differences in the right insula an important mediator for increased vs lesser disgust sensitivity? Is a bigger insula in the conservative participants' one explanation for why conservatives are more sensitive to disgust? Are there additional structures involved when conservatives and liberal process disgust? These and other questions will need to be addressed in future studies.

Conservatives and liberals generally show distinct patterns of preferences when it comes to social hierarchy. Conservatives are generally more favorable to social hierarchy and authority whereas liberals value egalitarianism. The anterior insula (AI) and ACC are hypothesized to be involved in processes related to aversion for inequality and empathy (Singer et al., 2006). Consequently, Chiao et al. (2009) examined the connection between social

hierarchy preferences and neurocognitive functioning. They found that individuals who preferred social hierarchy showed less activity within the AI and ACC, in response to pain in others. Conversely, those who held more egalitarian views had increased activity in those areas. Do these findings imply that conservatives are less empathetic in response to others' pain, because of a lesser activation in AI and ACC? Could there be other neural processes that induce a decrease in empathetic concerns in conservatives? Conversely, are liberals more egalitarian because of higher functional activation in the AI and ACC? Furthermore, would the responses vary if other persons expressing pain were relatives or close friends? Studies have shown that conservatives consider in-group loyalty a moral virtue (Graham et al., 2009) which introduces the possibility that conservatives might show greater neurocognitive reactivity in response to in-group members than would liberals. Questions like these should also be addressed in future studies.

The amygdala is consistently associated with fear and threat responses (LeDoux, 2000). Moreover, conservatives are generally more sensitive to threat than liberals (Jost et al., 2008) and show heightened skin conductance responses (SCR) to threatening images. This assumption motivated Kanai et al. (2011) to investigate whether amygdala volume would vary with political orientation. Indeed, conservatives on average had increased gray matter volume in the right amygdala, whereas no signs of such an association was apparent in liberals. Furthermore, higher SCR is a sign of autonomic arousal, which is hypothesized to reflect amygdala activity. Considering the findings presented here, there is evidence supporting the assumption that conservatives recruit their amygdala to a larger extent in response to threat but also possess a larger right amygdala. However, it is important to realize that what is considered threatening- might vary within individuals and thus recruit more or less amygdala depending on the stimuli. Potentially, there could be stimuli that evoke threat responses in liberals whereas not

as much in conservatives. Future studies should plausibly test threat reactivity and amygdala recruitment in response to various types of threat evoking stimuli.

Conservatives are on average more prone to in-group favoritism than liberals (Graham et al., 2009). In a review, researchers examined the neural basis for in-group preferences, and found evidence of MPFC being involved in in-group favoritism. In another study, researchers found that conservatives showed more activity in the dMPFC in response to liberals than the other way around. One interpretation of this could be that dMPFC is recruited in out-group processing. In fact, dMPFC has increased activity in response to dissimilar others than similar others (Rilling, Dagenais, Goldsmith, Glenn, & Pagnoni, 2008). On the other hand, Lewis et al. 2012 found that individuals favoring typical liberal values had increased dMPFC volume. This is not consistent with what one would assume, considering that conservatives recruited more dMPFC in response to outgroups and dMPFC being involved in out-group processing. However, given the fact that the MPFC is shown to play an important role in social cognition, it should therefore be involved in various unrelated as well as similar social processes (Amodio & Frith, 2006). MPFC would plausibly be more active in some individuals than others, depending on the type of situation and different portions of the MPFC would possibly be larger in some than others. Conservatives for instance, might recruit the MPFC more during in- out group processing because of other brain areas sending feedback to the MPFC, whereas liberals generally recruit the MPFC more in many other situations., which leads to increased volume. All things considered, additional studies are needed to unveil the specific neural processes involved in in-out-group processing. One subject for examination could be whether different types of in-out-group interactions, such as race, kinship, citizenship - affects neural process differently. Perhaps there could also be variations in specifically MPFC recruitment in conservatives and liberals, depending on exactly who the in-out-groups are. Furthermore, future research could consider the

possibility of additional brain areas involved in in-group and out-group processing. Currently, there is some evidence that amygdala plays a role when processing racial out-groups (Rilling et al., 2008). Although conceptually related, racial out-group processing might however entail properties that dissociate from non-racial out-group processing and therefore recruit the amygdala. Similarly, threat processing and in-out group preferences might also be related (Rilling et al., 2008) thus being another possibility that the amygdala is recruited in certain types of in-out group processing.

In the earlier section about cognitive styles in the conservative and liberal brain, studies were presented regarding different neural properties in conservatives and liberals, in the face of required cognitive control and cognitive complexity. Amodio et al. (2007b) were the first to find that liberals relative to conservatives showed greater activity in the ACC when engaging in self-regulation tasks, such as the go-no-go task, as well as better results in the task. Variations of the go-no-go experiment have since then been conducted, showing similar results. Moreover, in another study by Amodio et al. (2008) the researchers found that liberal minded individuals were better able to regulate their intergroup bias. This is considered a self-regulatory process and thus the experimenters hypothesized that the variability in ability to regulate their intergroup bias was facilitated by a better cognitive monitoring ability as well as increased activation in the ACC. Furthermore, in Kanai and colleagues' study a whole brain analysis was implemented on conservatives and liberal participants. They found that the liberals had increased gray matter in the ACC. The evidence clearly suggests that liberals and conservatives might dissociate when it comes to conflict monitoring, as well as differences in ACC recruitment in the face of cognitive complexity. Future studies could however benefit from varying the type cognitive tasks and seeing if that would lead to different behavioral and neural outcomes in conservatives and liberals. Moreover, it is interesting that regulating one's' intergroup bias is related to conflict

monitoring. The relationship between conflict monitoring and other biases would therefore be interesting to explore. Another thing to consider when it comes to recruitment of the ACC in response to cognitive tasks is: did increased activity in liberals in the ACC when engaging in the go-no-go task occur because of a generally larger ACC or is it that the increased ability to recruit ACC has in turn led to structural changes? Another possibility is of course that both occur bidirectionally.

Risk taking and decision making are two processes both related to cognitive conflict. Schreiber et al. (2013) examined the neural correlates in conservatives and liberals when engaging in a risk-taking decision making task. The results showed that liberals had increased activity in the left posterior insula, bordering the temporo-parietal junction whereas conservatives showed increased activation in the right amygdala. Risk-taking behavior was however the same, independent of political orientation. Increased Amygdala activity in response to threat as well as gray matter volume has earlier been linked to conservatism. Could it be that this structure is recruited in conservatives in more situations than in liberals and if that is the case, could that be one explanation to the current findings of a larger amygdala in conservatives?

Conservatives and liberals differ on personality traits, as one can expect. On measures, such as extroversion, agreeableness, openness and empathy liberals score higher. Based on these findings, Newman-Norlund et al. (2013) sought to explore whether the human mirror neuron system (hMNS) could be an underlying mechanism. Consequently, the researchers expected liberals to show greater resting state functional connectivity than conservatives. The results from the fMRI scan suggested that liberals had greater connectivity in core components of the hMNS than conservatives. Whereas liberals possessed greater connectivity between the inferior frontal gyrus (IFG) and angular gyrus (ANG) in both hemispheres, conservatives showed more robust connectivity between the IFG and the supramarginal gyrus (SMG). Based on what is

known about the interplay between these areas, researchers speculated that these findings would reflect a favorable approach towards very close relationships in conservatives whereas in liberals, it would reflect a preference for a broader social connectedness. Although very speculative, this hypothesis is in fact consistent with the findings that conservatives have heightened in-group preferences whereas liberals are more open as well as more concerned with social equality and exhibit less in-group preferences. Another interesting finding in this study is that the differences observed were in 7 out of 9 times located in the left hemisphere. According to the researchers this was noteworthy as they hypothesized that particularly the left hemisphere might be important in understanding political orientation. This assumption however, is rather general and non-specific. Thus, it ought to be refined in order for one to be able to draw more concrete and specific conclusions. Furthermore, the study was a pilot study and only involved 24 participants. A sample size this small could be thought to undermine reliability and statistical power (Button et al., 2013) and thus we should hope for other scholars to replicate and extend studies on the hMNS in relation to political orientation.

In the integrative review, Kennis et al. (2013) sought to explore the neural correlates of a revised model of Gray's reinforcement sensitivity theory of personality (RST). Researchers found that the neural correlates of the behavioral approach system (BAS), which among others is related to typical liberal personality traits (-such as sensation seeking, novelty seeking and openness to experience)- was characterized by increased activation in the ACC and amygdala in response to cognitive tasks and positive stimuli. Behavioral inhibition system (BIS) is related to typical conservative traits, such as conscientiousness and threat sensitivity. The neural correlates of BIS were characterized by significantly increased amygdala activation, especially in response to negative stimuli. BIS was also associated with decreased functional connectivity between the amygdala and the ACC, PFC and Hippocampus. Although both BAS and BIS operate in all

humans, individual differences exist as some individuals are more inclined towards either BAS or BIS. Logically, as conservatives are more sensitive to threat and disgust, one could speculate that conservatives are more governed by BIS than liberals. Conversely, BAS might be more prevalent in liberals. Based on studies presented in this essay, liberals are thought to recruit the ACC more than conservatives in cognitive tasks as well as having larger gray matter volume in that structure. Thus, the findings in the review suggesting that BAS related traits are related to increased ACC activation- are consistent with the findings suggesting that liberal individuals have larger ACC and increased activation in that area. In contrast, the findings in the review in which BIS is related to increased amygdala activation, is consistent with findings presented in this essay where conservatives had increased amygdala activity and gray matter volume.

The studies and their findings presented in this essay, have now been discussed. There are however some general reflections based on the findings that have not been addressed. As noted in an earlier section, there were situations where reminders of cleanliness/physical purity made people- regardless of political orientation- shift towards more conservative attitudes. This suggests that political attitudes can shift in some situations, at least in the short term. It would therefore be interesting to explore whether the situations need some essential components for this to occur. Perhaps the situation needs to include something very emotional and potentially threatening. Another thing that could be examined is whether the shift in attitudes remains even after a period of time. Further, disgust evoking situations could potentially alter neural function depending on circumstances, and perhaps even brain structure in the long term. It would therefore be of interest to examine whether individuals in countries and societies living under increased threat from microbes and dirt during their whole lives- are more conservative, house more conservative leaning people as measured by percentage, as well as have increased functional

activity in disgust related brain areas, such as the insula, as opposed to individuals living in relatively clean places.

Despite all the possibilities with brain-imaging, limitations are always prevalent when measuring brain activation in response to psychological phenomenon. To tackle these problems, scholars will need to employ different techniques and strategies to begin to solve some of the issues. According to Jost et al. (2014), it is absolutely necessary to adopt methods that involve sequential research stages where interpretations of neural and behavioral processes are cross-examined. Another issue is the chicken and the egg problem. To tackle this, it will require multiple and innovative methods that make it possible to isolate causal mechanisms. A useful method is the Transcranial Magnetic Stimulation (TMS) which applies small magnetic fields to activate or deactivate cortical regions, thereby enabling researchers to draw causal inferences about the impact of brain function on cognitive and behavioral outcomes (Jost et al., 2014). The problem with TMS however, is that it does not produce magnetic fields large enough to reach and isolate subcortical areas such as the amygdala (Jost et al., 2014). To manipulate subcortical areas, it is possible to isolate causal mechanisms through application of neuromodulators (Jost et al., 2014). Furthermore, longitudinal methods can be helpful, if researchers manage to monitor changes in structure and activity over time (Jost et al., 2014).

Considering the evidence on psychological characteristics and tendencies in conservatives and liberals, might create a sense to the reader of this essay about what is important to each camp. Conservatives appear to be wary and extra sensitive to aversive stimuli whereas liberals might seem like they are less sensitive and better able to handle complexity. It is however important to be careful with value judgments. Our psychological functioning, tendencies and biases have most likely been selected for throughout evolution in order to solve different adaptive problems. For example, at a particular point, perhaps an increased carefulness and paying

attention to aversive stimuli might be a more rational behavioral response, rather than employing creative and complex behaviors. In contrast, in some instances, being more open and less judgmental might be advantageous than reacting drastically. Depending on the situation, the value of each behavioral response will vary.

As much as conservatives and liberals might seem to differ, both camps are humans and as such, are probably much more similar than dissimilar. We all undoubtedly experience feelings of hunger, love, anger, disgust, fear and preferences for certain groups and individuals. Therefore, one should be mindful and not refer to conservatives and liberals as two different species, who invariably approach situations completely different from one another. However, it is also important to note that we are not all completely the same. Just as there are differences within individuals, there could be differences between groups. In this essay, the evidence presented suggest some discrepancies between conservatives and liberals, ranging from existential to epistemic needs. Conservatives are on a general level more likely to accept inequality, oppose social change and have a heightened sensitivity towards threat and uncertainty. Liberals on the other hand are more likely to reject inequality, advocate social change, and to have a heightened ability for self-regulatory processes and cognitive complexity, such as uncertainty. According to the model of political ideology as motivated social cognition, all these tendencies are thought to stem from fundamental psychological alignments toward uncertainty, conformity and threat (Jost & Amodio, 2012).

Furthermore, divisions between conservatives and liberals- seem to even map onto neurocognitive functioning. Conservatives elicit higher functional activation in certain areas, particularly the amygdala. Liberals elicit more activity in other areas, particularly the ACC. Evidence of structural differences have also been presented, with increased gray matter in the right amygdala and insula in conservatives and ACC in liberals. Considering the roles that the

amygdala and the ACC have, (where the former is involved in threat processing and the latter in cognitive control), the results fit well with the model of political ideology as motivated social cognition.

Cognitive neuroscience is sometimes referred to as the biology of the mind (Gazzaniga, Ivry, & Mangun, 2002). The assumption is that knowing the neural underpinnings of the mind, will help extend our understanding of human nature (Gazzaniga et al., 2002). Consequently, it should be just as crucial to incorporate a neurocognitive approach to political behavior and ideologies, as they too involve fundamental and complex psychological functioning.

One thing to consider when involving political ideology, is the possibility that what is considered to be conservatism and liberalism today will change and incorporate new features to those ideologies. In that case, political neuroscience will have to adjust. Anyhow, as conservatism and liberalism are traditionally and currently defined, there do exist psychological and neurocognitive discrepancies that are worth to consider. Time will however tell if these will be further confirmed and extended or whether researchers will have to re-evaluate. Luckily, the interest in this area of research is growing and thus we can expect to learn more about the neurocognitive properties in conservatives and liberals, as well as the neurocognitive differences between the two.

Divisions between people based on political ideology and world view are the cause of much conflict. Perhaps adding a neurocognitive explanation model could mitigate the frustrations and contempt towards political opponents and the way we relate to political behavior in general. Scientific curiosity has been shown in a study to counteract politically biased information processing. In this case, incorporating the biology of human psychology, might help us focus less on opposing variations that exist and instead, accept variety.

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