Gender Bias Camouflage: Unmasking Political Ideology Differences in Gender Stereotyping with Brain Electrical Responses

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Abstract

Recent research in Political Science and Psychology have uncovered how abstract sets of ideas, such as ideologies, can give rise to strong motivational forces. However, empirical work on identifying measurable psychological differences between ideologies has received less attention. The present study asks if our political ideologies exhibit measurable differences in response to our implicit reactions to gender, which can in turn impact public policy. To investigate this question, I utilized a mixed-methods approach that combines brain electrical activity recordings (Electroencephalography) and behavioral measures, together with surveys of political ideology, as participants engaged in a gender-stereotyping task. My study reveals how liberals and conservatives diverge when processing and responding to congruent and incongruent gender stereotypes. My findings suggest that when presented with a gender stereotype, liberals unlike conservatives are able to allot greater cognitive control mechanisms in order to restrain a stereotypical response.

Keywords: Ideology; Liberalism; Conservatism; Stereotyping; Electrophysiology; N400

Dedication

I dedicate this project to my parents. Terry Baker and Elverna Edwards-Mailloux, who instilled in me the love of learning from an early age. My parents have always been my trusted pit-crew through every academic and personal endeavor in my life. Thanks mom and dad for always believing in me and for encouraging me to strive for my dreams. I attribute everything positive in my life to you two.

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Last but not least, my brother Travis Baker. From you asking me how to sign on to the internet to me asking you how to plot ERPs has been a sobering experience. Baker and Baker.

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List of Acronyms

ACC	Anterior Cingulate Cortex
EEG	Electroencephalography
ERP	Event-Related Potential
IAT	Implicit Association Test
SOA	Stimulus On-set Asynchrony
STEM	Science, Technology, Engineering, Mathematics

Introductory Image

Illustration by: Saida Saetgareeva, for Adam K. Baker

Chapter 1.

Introduction

Gender stereotyping continues to impact the gender-based wage gap, lack of representation of women in STEM (Science, Technology, Engineering, and Mathematics) as well as other sectors, and upholding of human rights and freedoms. Due to persistent obstacles for men and women who are stereotyped by people in positions of social and economic power, there is a need to research why stereotyping occurs. Stereotype research has primarily focused on how social and cultural groups interact with each other. However, such empirical work on groups defined by political ideology has received less attention. Groups separated by political ideology, particularly those that differentiate on views concerning social change and inequality, can produce strong motivational forces that impact social biases (Jost, Glaser, Kruglanski & Sulloway, 2003a). The problem with investigating these social biases is that they often operate subconsciously (i.e. implicit bias), which makes it difficult to detect and control (Shaughnessy, Zechmeister & Zechmeister, 2005; Nosek, Greenwald & Banaji, 2007). As such, surprisingly little research has been conducted on how these groups may differ in their social biases and in the processes that give rise to gender stereotyping. Bringing together the disciplines of Political Science and Cognitive Neuroscience, I investigate if political ideologies exhibit measurable differences in response to biases based on stereotyped roles of men and women.

Over the past two decades, political scientists have noted that attitudes towards social change, inequality, authority, and tradition are among core features that differentiate liberalism from conservatism (Jost et al, 2003a, 2003b; Freeden, 1996, pp. 178, 340 and 425). For instance, individuals who identify themselves as liberals have reported higher levels of tolerance for uncertainty and greater openness to new experiences (Amodio et al. 2007; Jost et al, 2003a). By contrast, individuals who identify themselves as conservatives appear to be more persistent in their judgements and show a strong desire to preserve values and traditions (Ball et al., 2009). Recent advances in cognitive neuroscience have provided researchers with a window on to the psychological mechanisms that underlie such individual differences in political attitude. Notably, relative to conservatives, liberals have shown greater neural activity associated with conflict monitoring in the anterior cingulate cortex (ACC), located in the frontal portion of the cingulate cortex, which is involved in cognitive functions such as decision-making (Amodio et al, 2007). Furthermore, liberals have shown increases in brain matter volume in the ACC, primarily involved in cognitive control (e.g. controlling and inhibiting a bias) (Kanai, Feliden, Frith, Rees, 2011). On the other hand, conservatives have shown an increase in brain matter volume of the right amygdala – a subcortical structure placed anterior to the temporal lobe - which is primarily involved in the processing of emotional stimuli, particularly of negative valence (Kanai, Feliden, Frith, Rees, 2011). These findings provide convincing evidence for the proposition that such neural differences between liberals and conservations may extend to negative social decision-making, including those related to gender stereotyping. This raises the following question: Are political ideologies associated with differences in cognitive biases that contribute to gender stereotyping?

In order to investigate this question, I examined brain electrical activity associated with a class of social decision making to understand the neurocognitive mechanisms that support ideological differences in the evaluation and integration of gender stereotypes. I assayed the N400 event related brain potential (ERP), which has been implicated in recent stereotype research (White et al., 2009). Previously, the N400 was thought to reflect violation of a linguistic context by a semantically unrelated word (e.g. “I had dinner with my Mom and Dad/Door”) (Kutas M, Federmeier KD., 2011). The word “Door” is unrelated to the context of the sentence therefore acting as a violation of expectancy and generating a large N400 deflection. More recently, the amplitude of the N400 has been shown to increase as a function of the degree of violation of our social knowledge (Hagoort, Hald, Bastiaansen & Petersson, 2004), as in social group stereotypes (Huang et al., 2014), social norm violations (Mu, Kitayama, Han, & Gelfand., 2015) and racial stereotype accessibility (Hehman et al., 2011). Using an associative priming paradigm to study gender stereotyping, White et al., (2009) demonstrated that the pairing of “Woman” (prime word) and “Mechanic” (target word) elicited a greater N400 than “Woman” and “Nurse”, suggesting that this component is also sensitive to a violation in social expectations as in gender stereotyping.

It has been proposed that manipulating the stimulus onset asynchrony (SOA) – which is the time interval between a prime and target word - will activate automatic and controlled processing. Automatic processing does not require a deliberate effort, while controlled responses require thought and evaluation to make decisions (Neely 1977, Rug and Doyles 1994, Rugg and Doyle, 1994; Silva-Pereyra et al., 1999). These distinct types of mental processing may highlight differences in how individuals evaluate stereotypes, so by manipulating the time interval between a prime and target words, we

can measure both thoughtful and instinctive reactions between liberals and conservatives.

The aim of my study was to empirically identify measurable differences in gender stereotyping between liberals and conservatives by recording their brain electrical activity as they engaged in a modified version of the aforementioned gender-stereotyping paradigm (White et al., 2009). By accomplishing this aim, my project will help identify a neurocognitive mechanism of stereotype processing (N400 ERP). This will help researchers investigate stereotyping without the drawbacks of self-report measures, which are often relied on in the social sciences. Furthermore, by revealing how liberals and conservatives diverge when subconsciously evaluating gender stereotypes, we can add a more direct way of researching political ideology and behavior to the political scientists' toolbox. While this study is not intended to create a causal link between political ideology and gender stereotyping, it can provide new insights into new ways to research the social and political brain. Lastly, and perhaps most important, my study may further promote the integration of political science and cognitive neuroscience and may foster new and exciting opportunities for both disciplines to create knowledge together.

In the following, I begin with a discussion of ideology, then moving on to characterize the two major ideologies of liberalism and conservatism. This discussion serves to highlight the social, cognitive, and motivational characteristics that differentiate liberalism and conservatism. I then discuss the conceptual differences between prejudice and stereotyping before focusing attention on gender stereotyping in politics, along with the contribution of the media. This discussion is followed by an overview of how I plan to utilize neurophysiological techniques to accomplish the aims of my study,

along with the detailed explanation of the methods I have used. I conclude with the results of my study followed by a discussion on the mechanisms that support my findings.

Chapter 2.

Ideology

Political ideologies, in part, represent socially shared beliefs and goals on how life should be lived and how society should be governed. Various philosophies have been created on the best way this can be achieved. Many thinkers agree that ideology refers to philosophical ideas and theories that shape how people think and act and help explain how motivations give rise to the latter (Ball et al., 2009). Historically, Antoine Louis Claude Destutt de Tracy used the term ‘ideology’ to describe the systematic study of the enlightenment, as he believed people could use science to increase social and political conditions for people (Baradat & Lean 1997). The root of the term ‘ideology’ for de Tracy was centered on the science of ideas and their formation. De Tracy expressed that empirical learning is the only true source of knowledge, and supernatural phenomena should have no part in the formation of ideas. Today, ideologies are a way to explain rationally the complex mechanism of social and political phenomena (Freeden, 1996). To the extent that ideologies represent one’s beliefs, goals, and motivations in social and political life, it makes sense that different political ideologies should exhibit measurable social, cognitive, and motivational characteristics on the part of their followers.

I argue that it is possible to elucidate how abstract sets of beliefs and ideas, such as ideologies, can be reflected in the brain. In this chapter, I begin with a discussion on the definition of political ideology. I then move on to characterize the two major ideologies of liberalism and conservatism. This discussion serves to substantiate my claim that liberalism and conservatism show distinct social, cognitive, and motivational characteristics.

Defining Ideology

> Ideologies may be likened to rooms that contain various units of furniture. ... If we [enter a room and] find liberty, rationality, and individualism at its centre, while equality – though in evidence – decorates the wall, we are looking at an exemplar of liberalism. If order, authority, and tradition catch our eye upon opening the door, while equality is shoved under the bed or, at best, one of its weaker specimens is displayed only when the guests arrive, we are looking at a version of conservatism. Core, adjacent and peripheral units pattern the room and permit its categorization (Freeden, 1996, pp. 86–7).

Michael Freeden's metaphor encapsulates how political ideology is not a singular term with a single definition, but a "combination of political concepts" (Freeden, 1996, p. 140). For Freeden, different ideologies, such as liberalism and conservatism, share a number of core, adjacent, and peripheral concepts; diverging only when assigning significance to these shared concepts (Freeden, 1996). For the purpose of my study, I will begin will a simple definition of ideology offered by Monica Seliger (1976). As she states, "An ideology is a set of ideas by which men posit, explain and justify the ends and means of organized social action, irrespective of whether such action aims to preserve, amend, uproot" (Seliger, 1976, p.14). Arthur Denzau and Douglass North expand on this definition to ideologies by adding the role of social groups, in that "ideologies are the shared framework of mental models that groups of individuals

possess that provide both an interpretation of the environment and a prescription as to how that environment should be structured" (Denzau & North, 1994, pp. 4). Kent Tedin (1987) considers ideology as, "a set of attributes and values about the proper goals of society and how they should be achieved" (Tedin, 1987, pp. 65). Including a psychological component, Tedin adds, "An ideology has two distinct and at least analytically separate components -- affect and cognition" (Tedin, 1987, pp. 65).

If ideologies are a socially shared construct, which help individuals understand the social world and help them find ways to address their problem, it makes sense that ideologies reinforce psychological concepts relating to relational, epistemic, and existential needs or motives (Jost et al. 2003a). From this, we can begin to see the benefits of adopting a specific ideology since it can provide greater clarity in understanding and interpreting the social world. By adopting this social belief system, or "social blueprint", ideologies become ingrained in memory, acting as a cognitive schema consisting of an interrelated network of beliefs and opinions (Fiske et al. 1990, Hamill et al. 1985, Judd & Krosnick 1989, Lau & Redlawsk 2001). These beliefs and opinions have been shown to influence intergroup attitudes in a wide range of social science research. For example, conservatives are associated with stereotyping, prejudice, and intolerance toward a wide variety of groups, particularly those of a stigmatized group (Duckitt et al. 2002; Federico & Sidanius 2002; Lambert & Chasteen 1997). Furthermore, conservatives are more likely to endorse a traditional form of racism, whereas liberals tend to hide their racism, which is a tendency that suggests a form of cognitive control or, rather, a conflict between egalitarian ideals and biased impulses (Feldman & Huddy 2005).

These findings justify the formation of my hypothesis in that political ideologies may exhibit measurable differences in response to implicit biases based on gender stereotypes. I predict that both liberals and conservatives will exhibit some form of implicit (i.e. subconscious) bias, but will diverge when given the chance to hide their biases. To operationalize conservatism and liberalism in my study, we need more than a basic definition of ideology. Rather, I need to develop how liberalism and conservatism are different from one and another theoretically and empirically and to address the question of whether or not these differences can extend to differences in gender stereotyping.

Liberalism

According to McCloskly & Zaller (1984), liberalism can be seen as the following:

> Politicians and the policies they espouse . . . are usually described as liberal if they seek to advance such ideas as equality, aid to the disadvantaged, tolerance of dissenters, and social reform (McClosky & Zaller, 1984, p. 189)

Most liberals agree that people must be free to decide for themselves what goals and aspirations to pursue in life (Ball et al., 2009). According to Ball (2009), liberals believe the individual is the best judge of what is his or her best interests in life are, and the individual should be able to live as she or he sees fit, as long as it does not affect the freedoms of others (Ball et al., 2009). A core belief of liberalism is that all individuals must be equal and have the same rights as all other individuals. This includes the right to protect their rights, use of reason, and the tolerance of others choices and decisions. Liberals also believe in freedom (speech, press, religion, and trade), toleration (religious tolerance), and individualism (individual autonomy), while downplaying the need for power (ability to influence the behavior of people), authority (enforce obedience) and

tradition (Dunn, 1993). J.H. Newman suggested that liberals are more skeptical when something is not understood to them (Newman, 1890, pp. 294), highlighting how liberals are less concerned with preserving traditions and values and more concerned with progression. More recently, individuals who identify themselves as liberals have reported higher levels of openness, tolerance for uncertainty, and progressiveness towards new experiences (Amodio et al. 2007). According to Amodio et al. (2007), liberals reported higher levels of tolerance for uncertainty and greater openness to new experiences on psychological measures, whereas conservatives reported greater conscientiousness (Amodio et al., 2007). This further suggests that liberals saw themselves as more flexible and open to new ideas and experiences (Carney et al., 2008).

Psychologically, liberals have some distinct neurocognitive differences compared to conservatives, especially when relating cognitive control to emotional stimuli. Amodio et al. (2007) first showed this by investigating the cognitive control system of liberals and conservatives in a Go/No-Go task, used to examine the ability to inhibit an initial response. liberals and conservatives were required to make fast responses to frequently presented stimuli, such that the response became habitual. However, on a small number of trials, a No-Go stimulus appears which required the subject to withhold their habitual response. The results indicated that liberalism was associated with better performance on No-Go trials, indicating increased cognitive control in restraining a habitual response. In terms of brain structure, liberals also showed increases in grey matter volume in the ACC, primarily involved in cognitive control (e.g. controlling and inhibiting a bias) (Kanai, Feliden, Frith, Rees, 2011). This may explain why liberals are more open to new experiences and norms, as they have shown a greater ability to summon cognitive control mechanisms (Kanai, Feliden, Frith, Rees, 2011). One might explain this by the

ability of liberals to ‘override’ a tendency to make quick judgements, and utilize their cognitive control resources to express a more egalitarian response.

These characteristics of liberalism may provide a glimpse into how liberals react to social information, and how open or closed they are when faced with gender stereotypes that violate or comply with their beliefs.

Conservatism

Conservatism, on the other hand, involves more of a sense of order and tradition, possibly highlighting the reluctance of change. Erikson, Luttbeg, & Tedin, (1988) describe conservatism in the following way:

> Conservatives consider people to be inherently unequal and due unequal rewards; liberals are equalitarian. Conservatives venerate tradition and—most of all—order and authority; liberals believe planned change brings the possibility of improvement. (Erikson, Luttbeg, & Tedin, 1988, p. 75)

Conservatives, much like the name implies, generally share a desire to preserve, or rather, “conserve” something, whether it be a value, tradition, or trait (Ball et al., 2009). However, conservatism is much more complex than simply a desire to resist change. Modern conservatives do not all desire to preserve the same ideal or value, but rather this preservation is simply an easily identifiable trait when comparing conservatives to liberals (Ball et al., 2009). According to Michael Oakeshott (1991), conservatives prefer the familiar to the unknown, the actual to the possible, and the near to the distant (Oakeshott, 1991 pp. 259). Since conservatives find unfamiliarity uncomfortable, it may help explain why conservatives have been known to resist change (Stove, 2003), and exhibit a more structured and tenacious mode of thinking. David Stove (2003) suggests that conservatives feel there is no obligation to change the world

because humans are imperfect and unforeseen consequences make it impossible to know that any change will be for the greater good (Stove, 2003).

Psychologically, conservatives show tendencies to be persistent in their decision-making and judgements. This can be seen in the Go/No-Go task explained above by Amodio et al. (2007), which investigated the cognitive control system of liberals and conservatives. Unlike liberals, conservatives were associated with less sensitivity to response conflicts, along with an greater likelihood to makes errors of commission. The author's argue that these results indicate that conservatives would perform better on tasks in which a more fixed response style is optimal (Amodio et al, 2007).

In terms of brain structure, greater conservatism is associated with increased volume of the right amygdala –a key structure involved in processing of emotional stimuli, particularly of negative valence (Kanai, Feliden, Frith, Rees, 2011).This is consistent with the hypothesis that conservatives are driven by a negativity bias (Hibbing, Smith & Alford, 2014). These findings suggest that conservatives may not be able, or willing, to activate cognitive mechanisms that override an initial (biased) response when faced with gender stereotypes, highlighting their reluctance to promote change and equality.

To extend and improve upon previous researching investigating the identifiable differences between liberals and conservatives, I proposed to test if these differences extend to gender stereotyping. Since stereotyping is often confused with other forms of social phenomena, it is essential to provide a clear definition of stereotyping; ultimately addressing how it can influence the representation of men and women in politics.

Chapter 3.

Stereotyping

Due to the complexity of human interaction and social cues, we rely on stereotypes as a mental shortcut to evaluate members of unfamiliar outgroups (Cuddy, Fiske, & Glick, 2007). Stereotypes can be defined as knowledge or expectations tied to a particular social group (Hamilton & Cherman, 1994), and these mental shortcuts have been shown to influence negative behavior towards the stereotyped individuals (Amodio, 2008; Mitchell, Banaji, & Macrae, 2005). In Canada, social prejudices between ethnic, religious, gender and racial groups continue to fuel intergroup conflict and even violence Zafar & Ross (2015). This negative group interaction is fueled, in part, by discrimination due to learned stereotypes. (Amodio, 2008; Mitchell, et al., 2005; Oakhill, Garnham, & Reynolds, 2005). However, the distinction between stereotyping and prejudice has not always been clear, such that they are often perceived as interchangeable concepts. In order to conduct a comprehensive study of the neural differences between liberals and conservatives in response to gender stereotypes, it is vital to distinguish the concepts of stereotyping and prejudice.

Prejudice vs. Stereotyping

Stereotypes in a social context can act as a cognitive heuristic to help human's process large amounts of social information. They can also be used to help us organize

our immense past experiences and help us make predictions about other people's behavior in society. Simply put, stereotypes are a set of beliefs (positive or negative) associated with a certain group of people. For example, Black people are athletic or Jewish people are good with money. It only becomes an issue when people expect everyone they meet is going to conform to that particular pattern. Going back to our example, it is an issue if we automatically assume that, because someone is Black, that individual must be athletic or, because an individual is good with money, that individual must be Jewish. Since the human mind attempts conserve cognitive resources when performing a task, it is a way for people to use the least amount of mental processing resources to integrate a stimulus into a given context, such as a stereotype.

Prejudice, on the other hand, consists of negative emotions held towards a particular person based on their membership in a social group (Amodio and Devine, 2006). In terms of prejudice, encountering an African American might activate negative emotions that African Americans are violent due to a childhood that taught intolerance of African Americans. Although stereotyping and prejudice are seemingly similar, research has suggested they both depend on separate neural processes and can lead to different forms of behaviors (Mackie and Smith, 1998; Davis and Whalen, 2001; Amodio and Devine, 2006). For the purposes of my study, I will be focusing on a form of stereotyping that is based around the expected trails, roles, and behaviors of men and women.

Gender Stereotyping In Politics

Gender stereotypes are generalized views about the traits, roles, and behaviors that are expected to be performed by men and women. While gender stereotyping can be positive or negative, as in all stereotypes, it becomes harmful when it limits men's or

women's ability to develop their abilities, pursue academic/professional careers, and make choices regarding their life's ambition. Female stereotypes tend to identify women as more sensitive, compassionate, and emotional than their male counterparts. In contrast, males tend to be seen as decisive, assertive and strong. In politics, these positive stereotypes associated with males can be seen as an advantage because they match historical expectations for a strong leader, while female stereotypes are not associated with historical political leaders.

This disparity between stereotyped male and female qualities has been shown to impact voter behavior (Aalberg & Jenssen., 2007), and also leads to an imbalance in social and political participation (Thomas 2013). Thomas (2013) suggests that women's lower levels of political participation, due to gender stereotyping and discrimination, creates less desirable outcomes for society as a whole (Thomas, 2013). This type of gender inequality creates barriers to the level of women participation in community, social, and political levels. The political participation of women is strained due to the higher stereotypical traits that women face compared to men.

Toril Aalberg and Anders Jensen (2007) asked if the gender of a politician affects the way voters react when watching actors perform a political speech. Individuals rated a genuine political speech performed by a male and female. Their findings showed that the male politicians were rated to be more knowledgeable, trustworthy, and convincing compared to female politicians, even though they presented the identical speech. Taken together, this study showed that gender plays a significant role in the popularity of the candidate.

Monica Schneider and Angela Bos (2014) found that people are less likely to associate female politicians with traits that are advantageous to women, such as sensitivity and compassion (Schneider & Bos., 2014). According to Schneider and Bos (2014), “despite gains in the percentage of politicians who are female, there may still not be enough women in office for voters to form a consensus of stereotypical qualities” (Schneider & Bos., 2014, pp. 261). This study and others show a mismatch between stereotypes of woman in general and stereotypes of woman in politics. The results of this study show female politicians are at a disadvantage in terms of male stereotypical qualities while also not enjoying the positive stereotypical qualities of females (Schneider & Bos., 2014). Such an obstacle may speak truth to the unfortunate low levels of women in political power and highlights the problems associated with gender stereotyping.

However, it is important to note that stereotypes need to be activated with a context. That is, they are not activated automatically in all situations. For gender stereotyping, just because individuals are aware of expected traits, roles, and behaviors of men and women, they are not activated every time an individual encounters a man or a woman. However, seeing a man playing football may activate stereotypes associated with men and football, leading to judgement based of other male traits, roles, and behaviors. For an example in politics, if an individual sees presidential candidate Hillary Clinton on TV or see her name on a website heading, that individual will not automatically associate her with stereotyped female traits, roles, and behaviors. However, if she is framed in manner that highlights a female trait, role or behavior, it can cause voters to associate further female stereotypes to her. This exposes the impact media has on framing candidates based on gender.

The Contribution of Media

> Gender politics, once regarded as marginal, has emerged as one of the core dividing lines defining the identity of politicians, parties, issues and voters in America. In this context, not surprisingly, the way in which the media cover gender politics has become a matter of contention. (Norris, 1997: 1)

The media practices cited above have contributed to a number of issues surrounding the representation of women in media, especially when running for positions of power. According to feminist media scholars, the media is still not gender neutral. Elisabeth Gidengil and Joanna Everitt (2003) claim that the media is responsible for perpetuating the notion that politics is a game played only by men (pp. 574), resulting in women candidates commonly receiving less attention in the media than men (Carroll, 1994; Jalalzai, 2006). Furthermore, media exposure for women running for political power has traditionally focused less on relevant subjects and more on stereotypical female roles and traits, such as physical appearance and lifestyle (Anderson, 1995; McChesney, 1999). According to Gidengil and Everitt (2003), "And even when women were visible (in media), their coverage tended to be rather narrowly focused, dwelling on their viability and framing their issue competencies and/or personality traits in stereotypically feminine terms" (pp. 560). During the 1993 Canadian election, over fifty percent of political cartoons featured in the major Canadian newspapers framed women in sex-typed ways as witches or Cinderella's (Gidengil & Everitt, 2003, pp. 560). This unequal framing in the media creates a difficult situation for women because without conforming to the traditional masculine norms of political behavior, women will not receive adequate visibility (Gidengil & Everitt, 2003, pp. 560-1). This contributes to discrimination against women because media and information tools are modulated by patriarchal values (Blazquez, 2008). Taken together, media representation for woman

continues to contribute to an underrepresentation of women in politics (Gidengil & Everitt, 2003; Anderson, 1995; McChesney, 1999).

Despite the misrepresentation of women in the media, women's progress in the political arena has been significant over the last two decades (Banducci, Gidengil, & Everitt, 2012). Women continue to be successful as prime ministers as well as in positions in high national political office, although still not at the same rate as men. These increases have paved the way for a younger generation of women who aspire to serve in the political arena. However, despite the progress made, there are still major obstacles for women who are stereotyped against by people in positions of social, economic, and political power. It is safe to say that more progress is required. My research points to a new direction in which we can research gender stereotyping with a wide range of applications. I believe a fruitful way of revealing how and why we still use gender stereotypes in society lies within the brain.

Chapter 4.

Neurophysiological Contribution

The simplest way to measure and research stereotypes is to ask people to respond to stereotype associations. For example, "When you think of a cardiac surgeon, what prototypical mental image do you produce? Are they White or Aboriginal? Are they Male or Female?" Since these questions can be politically incorrect, participants are often driven to answer with a conscious or unconscious motive to seem like a good person, a phenomenon known as social desirability effect, which skews research results (Shaughnessy, Zechmeister & Zechmeister, 2005). To address this problem and acknowledge that stereotypes are largely implicit (subconscious), the Implicit Association Test (IAT) measures implicit prejudices, stereotypes, and subconscious attitudes (Greenwald, McGhee & Schwartz, 1998). The IAT tests a person's automatic associations between mental concepts by measuring the speed (reaction time) with which they associate target concepts (e.g. black people, women) with negative or positive words (Greenwald et al., 1998). However, the IAT has two major flaws. First, the IAT is dependent on the reaction time of the participants, which has been shown to vary significantly (Nosek, Greenwald & Banaji, 2007). Second, the IAT does not take into account the effect of age (e.g., older participants have longer reaction times and therefore stereotypes may appear more pronounced). By using a multi methodological approach, my research eliminates social desirability effects and the limitations of the IAT by utilizing electroencephalography (EEG) and event-related potentials (ERPs).

Electroencephalography (EEG) and Event-Related Potentials (ERPs)

Electroencephalography (EEG) roughly translates to “electrical brain photography”. EEG is a noninvasive measure of neuronal activations in the brain. In the cerebral cortex, there are specialized neurons called apical pyramidal cells, which act as the input and output cells of the cortex. These cells are arranged parallel to each other and perpendicular to the cortical surface. At the synapse between two neurons, neurotransmitters move across the synaptic cleft and bind to the post-synaptic membrane. This causes ion channels to open and positive ions rush into the cell. With the positive ions rushing into the cell, the extracellular space around the neuron becomes negatively charged. In a distant part of the neuron, ions eventually leave the cell, resulting in an outward flow of ions. The combination of these intricate processes creates an electrical dipole between different parts of the neuron (an ‘electrical field’). While the electrical field of a single apical pyramidal cell may be tiny, the combined electrical fields of large populations of pyramidal cells arranged in the same orientation and depolarizing together creates a summed field potential that propagates through the brain tissues and can be recorded on the scalp surface in the typical EEG.

When humans receive a stimulus, a sequence of physiological processes takes place when our brain detects the stimulus, then discriminates and evaluates it, eventually preparing the adequate response. While EEG reflects the activity of billions of neurons firing at different rates for different reasons, Event-Related Potentials (ERPs) represent millisecond-by-millisecond reflections of the proportion of neural activity that is specifically evoked in response to a given stimulus, response, or cognitive process.

ERPs can be subdivided into small segments (components) based on their positive or negative polarity and their timing (N2pc, N2, P3, N400). Each ERP component is thought to reflect a specific stage of information processing or cognitive process. Due to the precise temporal resolution of electrophysiological recordings, ERP research has proven its value in studying various cognitive processes (Kutas & Hillyard, 1980), which makes it ideal for the present study of stereotypes between liberals and conservatives. I paid particular attention to an ERP component called the N400, which is specifically sensitive to the modulation of meaning at the semantic/associative level and highlights semantic and pragmatic rule violations (Kutas and Federmeier, 2000).

The N400 component

The N400 is a negative deflection at roughly ~400ms following stimulus presentation. Originally, the N400 was thought to represent a mechanism that detects anomalies during sentence processing in response to a word whose meaning does not fit a semantic expectation set up by the sentence context (a semantically incongruent word). This would lead to a need for “reprocessing” in attempt to interpret the meaning of the incongruent sentence (Kutas & Hillyard, 1980b). According to Kutas & Fredermerier (2011), the N400 with its unique morphology, is specifically associated to semantic processing, and it is differentiated by ERP components produced by simply deviant or unexpected stimuli (Kutas & Federmeier, 2011). For example, if a subject is presented with a sentence, one word at a time such as, “For breakfast my mother made me bacon and socks”, in order to look at the N400, the time epoch surrounding the last word would be analyzed (the word “socks”). This is called an expectancy-violation, in which the last word of a sentence violates the expected last word. This N400 would not be present

when the last word of the sentence does fit the semantic context of the sentence (the word “eggs”), as seen in fig. 1.

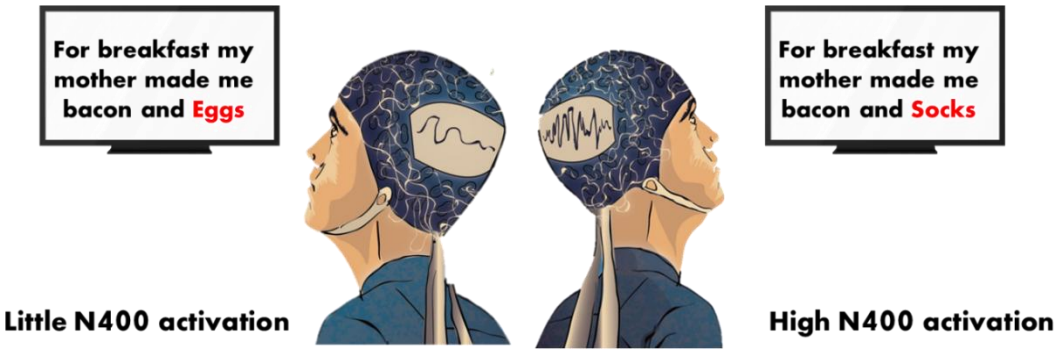

Figure 1 **N400 activity is greatest when a word is out of place and violates the context of the sentence as seen in this figure.**

The N400 has also been observed when words are presented one at a time and the meaning of the current word is related or unrelated to the preceding word, as for word-pair associations in a lexical decision task. In such paradigms, larger N400 amplitudes can be seen when presented with an incongruent word-pair, indicating increased effort in accessing information in long-term memory (Kutas and Federmeier, 2000*).* For example, when presented with the word ‘coffee’ followed by ‘mug’, there is little difficult mentally connecting the word ‘coffee’ and ‘mug’. However, if presented with the word ‘coffee’ followed by ‘socks’, it would be more difficult to access from memory. The larger amplitude seen in response to the incongruent word is thought to reflect the increased neural resources needed to process the incongruent word-pair as compared to the congruent word pair (Kutas & Federmeier, 2011). The N400 is specific to semantic anomalies, since similar anomalies in the realm of grammar generate a distinct ERP signature (e.g., grammatical errors such as “coffee” + “muge”, Kutas & Hillyard, 1980b).

The relationship between Stereotypes and the N400 ERP

Stereotypes can be conceived as highly established social norms made up of semantic associations stored in long-term memory (Gaertner and McLaughlin, 1983; Dovidio et al., 1986; Blair and Banaji, 1996). Hence, it has been proposed that the N400 can be used to evaluate stereotype associations stored in memory. Using a gender stereotype paradigm, White et al., (2009) showed that the pairing of “Woman” and “Mechanic” elicited a greater N400 than “Woman” and “Nurse”, suggesting that this component is sensitive to gender stereotyping. More recently, the amplitude of the N400 has been shown to increase as a function of the degree of violation of our social knowledge (Hagoort, Hald, Bastiaansen & Petersson, 2004), as in social group stereotype (Huang et al., 2014), social norm violations (Mu, Kitayama, Han, & Gelfand., 2015) and racial stereotype accessibility (Hehman et al., 2011). Taken together, it appears that the N400 may represent the ideal component to focus on for our investigation of gender stereotyping between liberals and conservatives.

Stimulus Onset Asynchronies and Depth of Semantic Processing

When a subject is asked to decide whether a target word (e.g. ‘mechanic’) is congruent or incongruent to the prime word (e.g. ‘male’), reaction times are faster if the word-pair is semantically related as compared to unrelated. This reduction in response time is referred to as the ‘semantic priming effect’ (Collins and Loftus, 1975; Neely, 1977). The two proposed mechanisms that account for this effect are automatic processing and controlled processing (Neely 1977, Rug and Doyles 1994, Rugg and Doyle, 1994; Silva-Pereyra et al., 1999; Brown et al., 2000; Chwilla et al., 2000; Hill et

al., 2002). It has been suggested that automatic processing is the relevant mechanism at short intervals between the presentation of prime and target words (stimulus onset asynchrony; SOA). In contrast, controlled processes are engaged only at SOAs greater than 400 ms (Neely, 1977). In the long SOA condition, there is ample time to process the association between the prime and target word in a serial manner, suggesting subjects may be driven to perform a deeper and more meaningful processing of the stimuli. In the shorter SOA condition, subjects may rely on automatic processing, suggesting that there is less conscious reflection and evaluation of the association between stimuli. To investigate the egalitarian and progressive nature of liberals compared to conservatives, I manipulated the stimulus-onset asynchrony (SOA) to highlight differences in how individuals evaluate stereotypes. By including short (150ms) SOA and long (700ms) SOA conditions, we can measure both thoughtful and instinctive reactions between liberals and conservatives.

Current Investigation

To extend and improve upon previous research investigating differences between political ideologies, my aim was to identify measurable differences in gender stereotyping between liberals and conservatives by recording their brain electrical activity as they engaged in a gender-stereotyping task. My predictions consisted of the following. First, I predicted that my study would replicate previous findings by White et al., (2009), such that incongruent gender word pairs would elicit greater N400 amplitudes in response to incongruent gender stereotype word-pairs. Second, I predicted that if given more time to process the prime word (e.g. ‘Male’ or ‘Female’), liberals would exhibit a diminished N400 deflection between congruent and incongruent

word-pairs, implicating increased cognitive control in restraining a stereotypical response. Furthermore, I predicted that in the short (150ms) SOA condition, both liberals and conservatives would show similar N400 amplitudes in response to congruent and incongruent word-pairs, highlighting automatic processing. However, in the long (700ms) SOA condition, I predicted that liberals would show less need to “reprocess” the meaning of the incongruent word-pair, reflected by a reduction in N400 amplitude. Third, I predicted that liberals would show greater uncertainty in classifying incongruent word-pairs (reflected in their accuracy), along with a greater increase in response time when determining if word-pairs were congruent or incongruent. In contrast, conservatives would show little differences in response time and accuracy in short and long time intervals between stimuli, suggesting a highly consistent and efficient evaluation of stimuli, further highlighting their more structured and tenacious mode of thinking (Ball et al., 2009).

One of the core aims of science is to simplify. I believe the most fruitful way to study ideological differences in response to gender stereotypes with any scientific accuracy is to strip away everything but the physiological functions. Utilizing a mixed-methods approach with a combination of brain electrical activity recordings (EEG) and behavioral measures, together with surveys of political ideology, I believe I have achieved this aim. By stripping away the layers of the ideological mind and revealing its physiological functions, perhaps we can gain better insight into new ways to study social and political behavior. Taken together, I believe this study contributes to efforts to address the gender based wage gap, lack of women in STEM, and failures to upload human rights and freedoms.

Chapter 5.

Methods

Participants

Subjects were split into two groups [Conservatives (7 male, 8 Female, aged 19-51, M = 28) and Liberals (7 male, 8 Female, aged 19-54, M = 24)]. All participants had normal or corrected-to-normal vision and none reported a history of head injury. Participants were undergraduate and graduate students recruited from Simon Fraser University, as well as individuals outside the university population and each received monetary compensation for their time. All participants gave informed consent prior to the experiment. The Simon Fraser University Research Ethics Board approved all aspects of this study, and all participants gave informed consent before participation.

Grouping

For the purpose of this study, participants were classified as either liberal or conservative by reporting their political attitudes on a 1 (extremely liberal) to 11 (extremely conservative) scale, with scores 5.5 - 6.5 being neutral. The questionnaire consisted of 3 self-identifying categories asking for participants' self-reported level of liberalism or conservatism. Individuals who had a combined score between 0 and 5.5 were classified as liberal (n=15, mean = 2.98, SE = 0.24) and scores between 6.5 and 11 were classified as conservative (n=15, mean = 7.03 SE = 0.3). Participants with

scores between 5.5 and 6.5 were excluded from analysis. This method to classify the political attitudes of participants on a self-identifying scale has been used in several previous studies in political psychology as a measure of political orientation (Jost, Amodio, etc).

The Social and Economic Conservatism Scale (SECS) was used as an addition to the self-identifying questionnaire to highlight the separation between liberalism and conservatism seen in the self-identifying questionnaire. The SECS has been shown to be a useful addition to measurements of political orientation in political psychology research by providing a multi-item measurement of political attitudes (Everett, 2013). Participants were given a list of 14 words or phrases that represented issues commonly important to conservatism and asked to rate them on a 'feeling thermometer' – "How positive or negative do you feel about each issue on a scale of 0 to 100", 0 representing very negative, and 100 representing very positive?" The 'feeling thermometer', along with the 12 issues, allowed participants to express their feelings while not requiring them to have specific social or political knowledge of the issues. Combined scores between 45 and 55 were considered neutral and were excluded from analysis. Individuals who had a combined score between 0 and 45 were classified as more liberal ($n=15$, mean = 36.2 SE = 2.7) and scores between 55 and 100 were classified as more conservative ($n=15$, mean = 59.0 SE = 1.9), $t(14) = -6.25$, $p < .001$. If an individual was classified as liberal on the self-identifying scale, yet scored as a conservative on the SECS, they were excluded from the analysis, and vice versa. For the purpose of this study, all individuals' classification on the self-identifying scale matched their classification on the SECS.

Stimuli

Stimuli consisted of gender stereotype word pairs derived from a previous study on gender stereotyping (White et al., 2009). Each word pair consisted of a gender category (Male or Female), followed by a target word. Target words from White et al., (2009) consisted of 14 female traits (e.g. sensitive, emotional), 14 male traits (e.g. brave, dominant), 14 female non-traits (e.g. laundry, doll) and 14 male non-traits (e.g. Soldier, cigars) Each target word was paired with both gender categories, making a total of 28 congruent word pairs (e.g. Women: Caring; Men: Sports) and 28 incongruent word pairs (e.g. Women: Hunting; Men: Ballet).

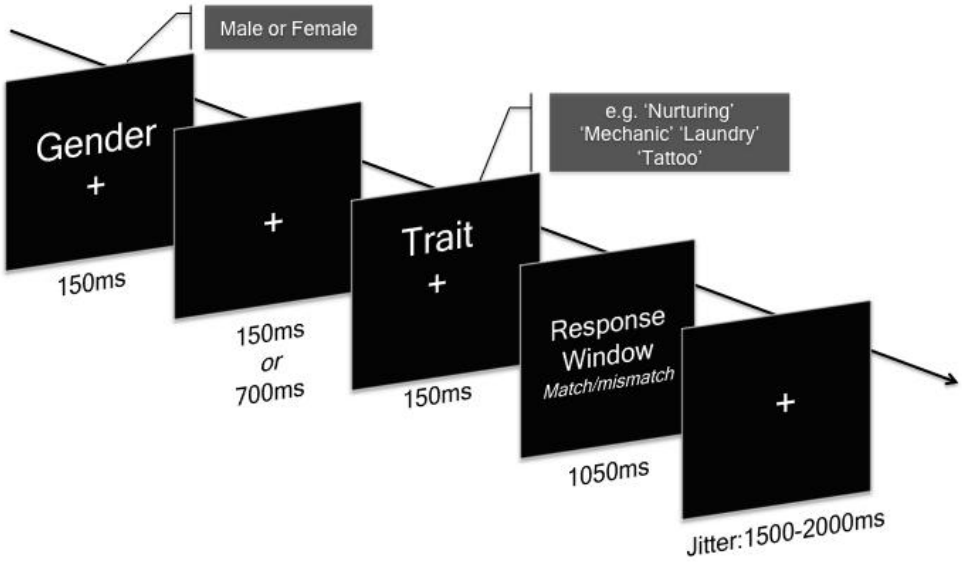

Figure 2 **Timing of word pair stimuli for each trial. Each word pair consisted of a gender category (Male or Female), followed by a target word.**

Procedure:

Participants were instructed to fill out a consent form, medical/demographical, self-identifying questionnaire, and Social and Economic Conservatism scale while they

were being prepared for EEG recording. Each participant was then taken a separate isolated room to be seated in a chair ~40cm away from a LCD computer monitor. First, instructions were given on proper EEG recording practices, followed by the task instructions. The experimenter informed participants that they would see a series of word pairs consisting of a Prime word (e.g. Male or Female) followed by a trait/non-trait target word. Each prime word (e.g. Male or Female) was presented for duration of 150ms, followed by an ISI (inter-stimulus interval) of either 150ms or 700ms, and then followed by a target word (150ms duration). The target word consisted of either a trait (e.g. sensitive, strong) or a non-trait (e.g. nurse, tattoo) that was stereotypically congruent or incongruent with one of the gender categories. Following the Target words, a 1050ms response window appeared and subjects were required to make a binary decision on whether the target word matched or mismatched the gender category. A central fixation cross was then presented on the screen for an interval randomly jittered between 1500-2000 ms. All subjects were counterbalanced to receive either the 150ms SOA or 700ms SOA in the first experimental trial block.

Data acquisition and reduction

EEG activity was recorded using a 64-channel Ag/AgCl electrode cap at standard 10-20 sites (BioSemi Active Two, Amsterdam), plus electrodes over the left and right mastoid. External canthi electrodes, such as vertical electrooculographic (VEOG) and horizontal electrooculographic (HEOG), recorded horizontal and vertical eye movements, and blinks. Voltages were recorded against a common mode sense (CMS) active electrode. Data were sampled at a rate of 512 Hz. Offline, EEG was digitally filtered (0.01 Hz high-pass, 30 Hz low-pass, zero phase, 12dB/octave slope), and re-

referenced to average mastoid (BESA 5.3). Artifact rejection consisted of visual inspection and semiautomatic methods to remove trails contaminated by blinks and eye movements. Electrodes were deleted from further analyses if there was a problem (e.g. if an electrode lost connectivity or malfunctioned). Epochs containing extreme activity at any scalp site were excluded from further analyses.

ERPs were created for each subject by selectively averaging the single-trial electroencephalography (EEG) for each of the four stimulus types, time-locked to target word onset. A 1000ms epoch of data extending from -200ms pre-stimulus to 800ms post stimulus, following the onset of the target word, was extracted from the continuous data file for analysis. To isolate the N400 from other overlapping ERP components, the N400 was evaluated for each participant as a difference wave by subtracting the congruent ERP from the corresponding incongruent ERP, separately for the 150ms and 700ms SOA conditions. N400 amplitude was then determined by identifying the peak amplitude of the difference wave within a 300-500 ms window following target word onset. For the purpose of statistical analysis, the N400 was evaluated at electrode site Cz (fig.3), where it reaches maximum amplitude. Scalp distributions were inspected to confirm the spatial distribution of the component (fig.4).

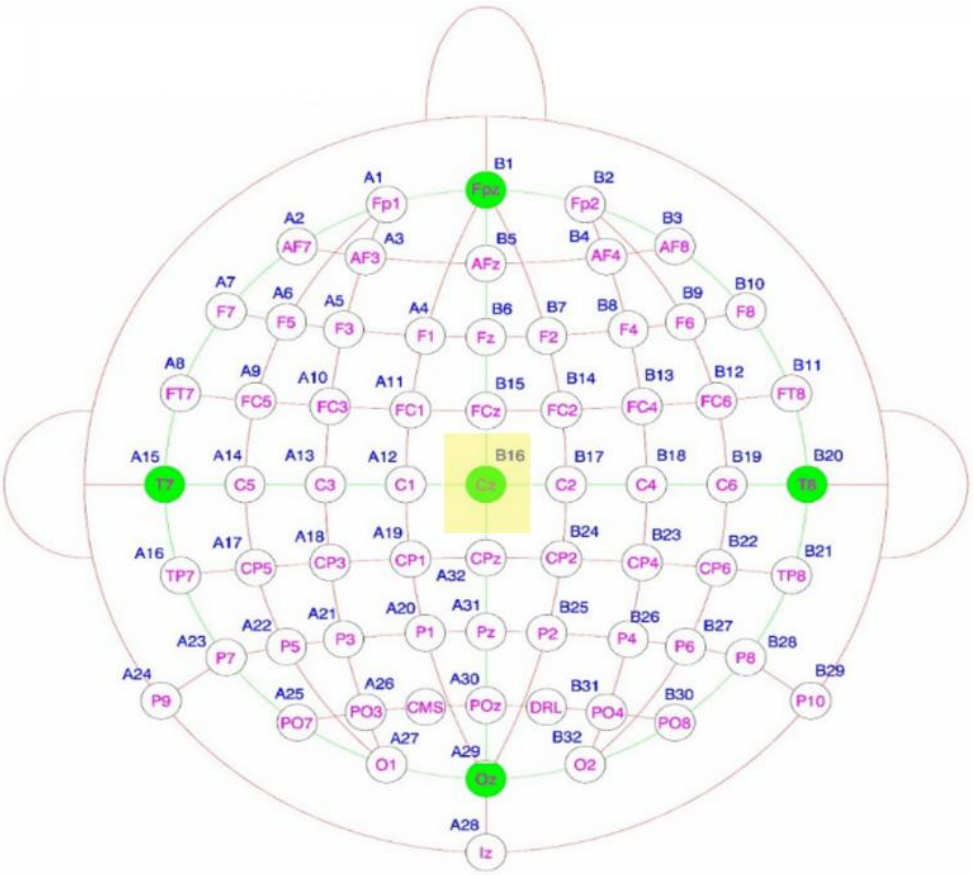

Figure 3 **64-channel Ag/AgCl electrode cap at standard 10-20 sites (BioSemi Active Two, Amsterdam) – Highlighted is electrode channel Cz, positioned on the central midline of the scalp (vertex).**

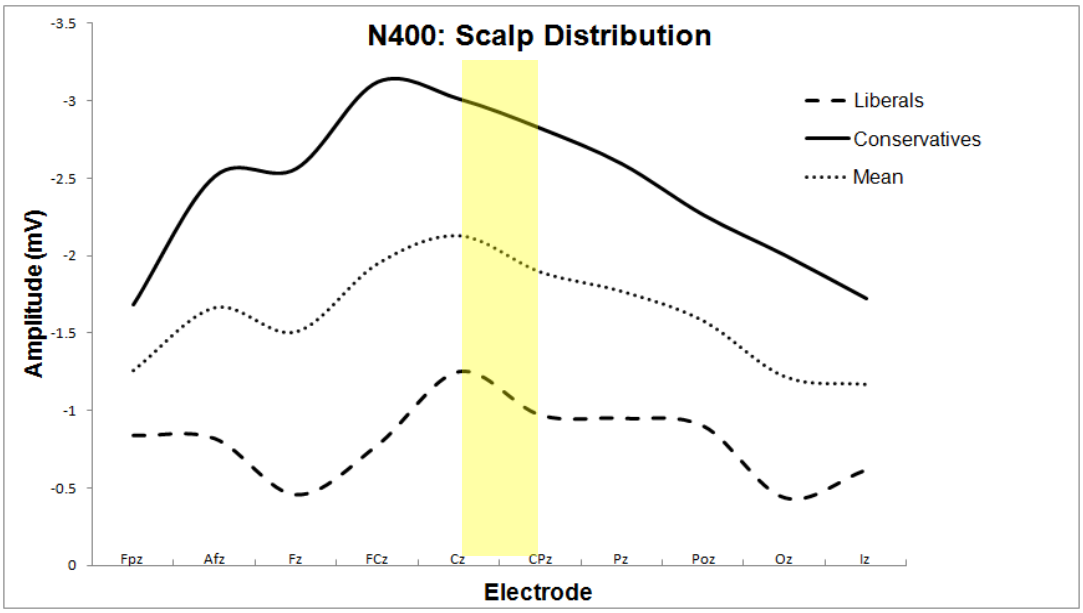

Figure 4 **N400 amplitudes as measured by the difference wave (incongruent – congruent) averaged across all trials for all electrodes are shown in Figure 4. Visual inspection reveals maximal N400 amplitude for electrode Cz.**

To test my predictions, I used a A 3-way mixed repeated measures ANOVA with Congruency (congruent vs. incongruent) and SOA (150 vs 700 ms) as within-subject factors. Group variables (Liberal vs. Conservative) were set as my between-subject factor.

Chapter 6.

Results

Reaction Time Results

A 3-way mixed repeated measures ANOVA with Congruency (congruent vs. incongruent) and SOA (150ms vs 700ms) as within-subject factors, and Group (Liberal vs. Conservative) as between-subject factor, revealed the expected main effect for Congruency $F(1, 28) = 82.83$, $p < .001$, $\eta 2 = .76$. Response times were longer for incongruent word pairs (M = 736.57ms, *SD* = 82.22) relative to congruent word pairs (*M* = 663.49, *SD* = 74.11), $t(29) = -9.18$, $p < .001$, $d = 1.0$, which is consistent with previous work (Oakhil 2005 and White et al., 2009). More importantly, there was a significant 3-way interaction of Congruency x SOA x Group ($F(1, 28) = 4.46$, $p = 0.04$, $\eta 2 = .14$). To interpret such effect, 2-way ANOVAs restricted to Congruent and Incongruent trials were conducted. For Incongruent trials the interaction SOA x Group was significant ($F(1, 28) = 5.85$, $p = 0.02$, $\eta 2 = .18$). In contrast, for Congruent trials, there was no hint of a significant SOA x Group interaction ($F(1, 28) = 0.27$, $p = 0.60$, $\eta 2 = .01$).

Table 1. **Comparison for reaction times and mean reaction time differences between liberals and conservatives for congruent and incongruent trials in 150ms and 700ms SOA conditions**

Liberal Participants

Congruency	SOA (m/s)	Mean Reaction Time (m/s)	Mean RT difference (m/s)
Congruent	150	671	-16.79
Congruent	700	688	
Incongruent	150	728	-37.5
Incongruent	700	765	

Conservative Participants

Congruency	SOA (m/s)	Mean Reaction Time (m/s)	Mean RT difference (m/s)
Congruent	150	640	-11.2
Congruent	700	651	
Incongruent	150	736	12.73
Incongruent	700	723	

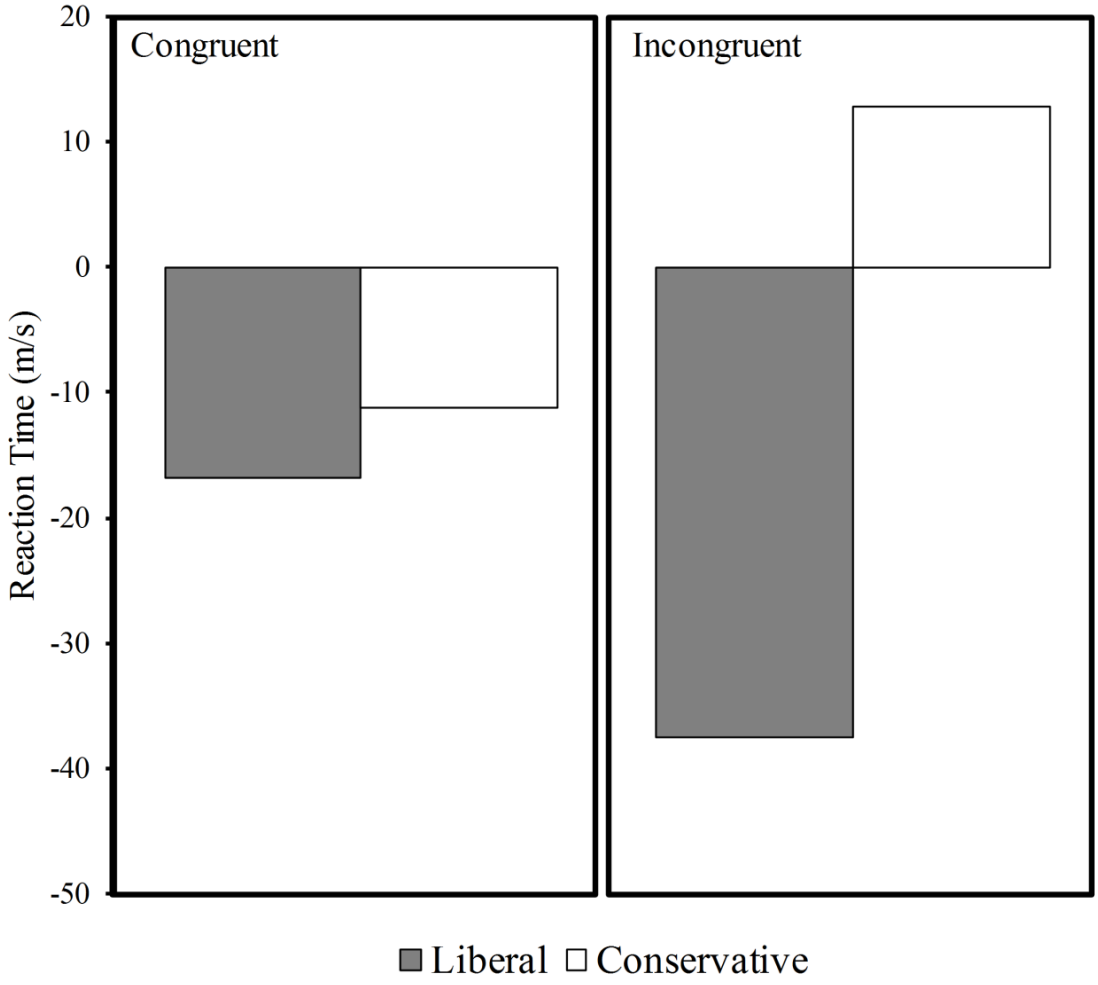

Figure 5. **Reaction Time Differences. Panel 1: Congruent trials. Panel 2: Incongruent trials. Each bar represents the difference in reaction time between the short (150ms) SOA and long (700ms) SOA.**

I then conducted paired-samples t-tests on the liberal and conservative groups to compare response times for incongruent trials in the short (150 ms) and long (700 ms) SOA conditions. Interestingly, only the liberals showed a significant response times increase between the 150ms (M= 728 ms, SD=73.74) and 700ms (M = 766 ms, SD=59.30) conditions; t(14)= -3.33, p = .005, d = 0.57. For conservatives, there was no significant response time increase between the short (150 ms) SOA and long (700 ms) SOA. These results suggest for incongruent trials of liberals, only the longer (700 ms)

SOA brought about significantly longer response times compared to the shorter SOA, implicating increased cognitive control in restraining the stereotypical response when SOA was increased in duration.

Accuracy Results

A 3-way mixed repeated measures ANOVA revealed a main effect of congruency $F(1, 28) = 35.67$, $p < .001$, $\eta 2 = .59$, replicating previous findings (White et al., 2009). Participants were more accurate for congruent word pairs (M = 87%, SD = .10) compared to incongruent word pairs (M = 68%, SD = 0.19), $t(29) = 5.82$, $p < .001$, d = 1.25. Further, the ANOVA revealed a main effect of Group $F(1, 1) = 11.47$, $p = 0.02$, $\eta 2$ = .21 such that conservatives displayed a significantly greater overall accuracy (M = 83%, SD = .08) compared to a much lower level of accuracy seen in liberal participants (M = 69%, SD = 0.13), $t(14) = -3.13$, $p = .006$, $d = 0.24$.

ERP Results

A 3-way mixed repeated measures ANOVA with Congruency (congruent vs. incongruent) and SOA (150ms vs 700ms) as within-subject factors, and Group (Liberal vs. Conservative) as between-subject factor revealed a main effect for Congruency $F(1, 28) = 47.23$, $p < .001$, $\eta 2 = .63$. This indicated that the N400 amplitude was larger for incongruent word pairs (M = -3.12 µV, SD = 3.25), in contrast to congruent word pairs (M = -1.45 µV, SD = 3.38), $t(29) = 6.66$, $p < .001$, $d = 0.50$, replicating previous work (White et al., 2009). There was also a main effect of SOA $F(1, 28) = 21.24$, $p < .001$, $\eta 2 = .43$, with the N400 amplitude being larger in the 150ms SOA condition (M = -3.70 µV, SD = 3.35), than in the 700ms SOA condition (M = -0.96 µV, SD = 3.92).

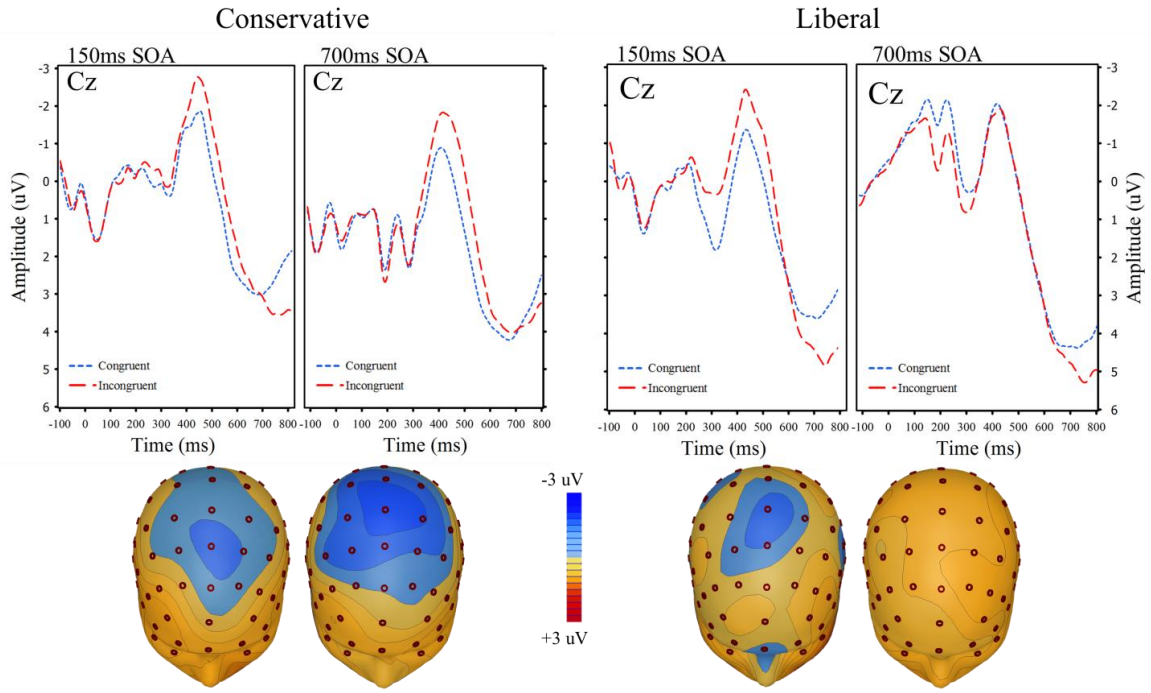

Figure 6. Grand averaged ERP waveforms of incongruent and congruent trials of liberals and conservatives, across both short (150ms) and long (700ms) SOA conditions. Visual inspection shows that only liberals showed a diminished N400 ERP in the long (700ms) SOA condition, possibly highlighting cognitive control.

More importantly, the 3-way interaction Congruency x SOA x Group was significant, $F(1, 28) = 4.55$, $p < .05$, $\eta 2 = .14$. To investigate the interaction further, I conducted separate 2-way repeated measure ANOVAs on each group separately. Only the liberals revealed a significant interaction of Congruency x SOA, $F(1, 14) = 6.65$, $p = .02$, $\eta 2 = .32$, while for conservatives there was no hint of significance, $F(1, 14) = 0.80$, $p = .38$. Post-Hoc contrasts (Bonferroni-corrected paired t-tests, alpha=0.025), indicated that in the 150ms SOA condition, the N400 amplitude for incongruent word pairs (M = -4.10 µV, SD =3.62) was significantly larger compared to congruent word pairs (M = -2.16, µV, SD =3.73$t(14) = 5.42$, $p<.001$, $d = 0.53$. However, in the 700ms SOA condition, liberals did not show a congruency effect as N400 amplitudes for incongruent word pairs

(*M* = -1.55, μV, SD =3.61) was not significantly different from congruent word pairs (*M* = -0.90, μV, *SD* =3.40), *t*(14) = 1.82, *p* >.05, *d* = 0.19.

To summarize, among liberals, the N400 effect was present for the short delay, but it was much reduced and not significant for the long delay. This is illustrated in Fig. 4.

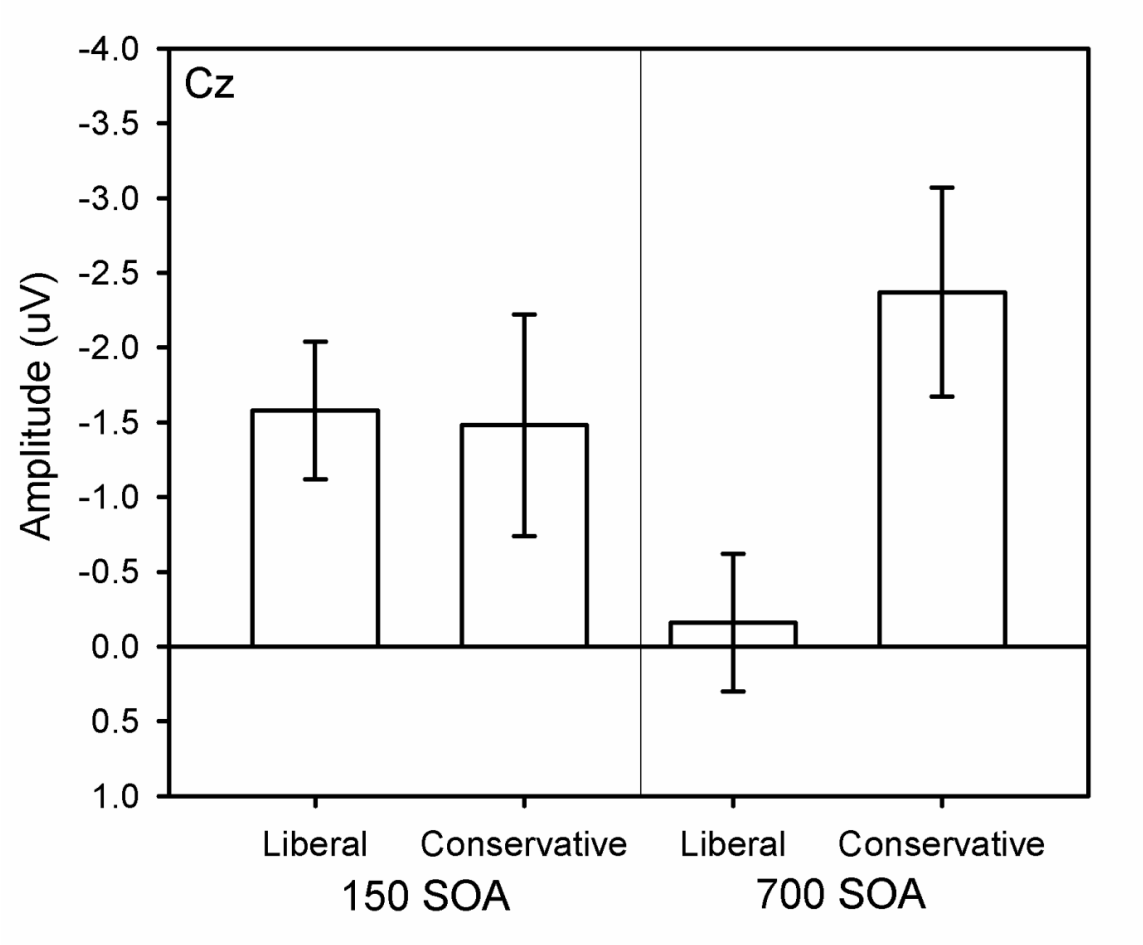

Figure 7 **Difference wave. N400 amplitude differences between liberals and conservatives separated by short (150ms) and long (700ms) SOA condition. Bar graph shows group differences were primarily driven by the long (700ms) SOA as groups did not differ in the short (150ms) SOA condition**

To further highlight the effects, a difference wave analysis was conducted (incongruent – congruent). A two-factor mixed ANOVA on the N400 amplitude with SOA

(150ms and 700ms) as within-subject factor, and Group (Liberal and Conservative) as between-subject factor revealed an interaction between SOA and Group, $F(1, 28) = 5.04$, $p < .05$, $\eta 2 = .15$. Post-hoc analysis revealed that in the 700ms SOA condition, the amplitude of the N400 was significantly reduced for the Liberal Group ($M = -0.16$ μV, $SE = 0.46$) compared to the Conservative group ($M = -2.40$ μV, $SE = 0.53$), $t(28)$ 2.65, $p < .05$. By contrast, for the 150ms SOA condition, no difference in N400 amplitude was detected between the Liberal ($M = -1.6$ μV, $SE = 0.46$) and Conservative ($M = -1.5$ μV, $SE = 0.74$) participants, $t(28)$ -0.12, $p > .05$. No main effect of SOA or Group was detected, $p > .05$.

Chapter 7.

Discussion

The aim of this study was to empirically identify measurable differences in gender stereotyping between liberals and conservatives. A difference in behaviour and brain electrical activity between participants of different political orientation (i.e., liberals vs. conservatives) was observed when participants made either quick, automatic decisions or slower, deliberate decisions. I achieved this by employing a variation of an established gender stereotyping task previously found to produce both behavioral and electrophysiological (N400) differences between congruent and incongruent gender stereotype word pairs (White et al, 2009). My predictions of both behavioral and N400 differences among liberals and conservatives were upheld.

Critically, N400 amplitudes differentiated the liberals and conservatives. While both groups replicated previous results of greater N400 amplitudes to incongruent than congruent semantic gender associations (White et al, 2009), the groups diverged at the longer 700ms SOA. Interestingly, conservatives exhibited a significant N400 effect across both SOA conditions while liberals showed a comparable N400 effect at only the short SOA. Unlike conservatives, liberals showed a diminished N400 effect at the longer (700ms) SOA. This important finding suggests that when given more time to process the association between the prime (male or female) and target word (e.g. ‘Mechanic’,

‘Strong’, ‘Sensitive’), only the liberals were able to allot cognitive controls mechanisms to resist a stereotypical response.

Importantly, behavioral results seem to support my ERP results. While the general pattern of longer response times and less accuracy for incongruent than congruent gender associations was replicated (White et al, 2009), only for incongruent trials of liberals, the longer (700 ms) SOA brought about significantly longer response times compared to the shorter SOA, implicating increased cognitive control in restraining the stereotypical response when SOA was increased in duration. In contrast, conservatives showed no significant difference in response time in congruent and incongruent trails between the short and long SOA. Furthermore, liberals were more uncertain in categorizing gender associations, reflected in the overall decrease in accuracy across both SOA conditions.

The most parsimonious interpretation of these findings is the following. People of different political ideologies process similarly *automatic* stereotypical gender associations when quick, intuitive judgements are required at the short (150ms) SOA. This can be seen with an unrestrained tendency to implicitly facilitate the gender-congruent stereotypical association, and produce a similar N400 deflection to the violation of the semantic context between target word and stereotypical gender prime. In these conditions, liberals display a comparable *implicit* gender bias as conservatives. By contrast, liberals and conservatives differ from each other when *explicit*, *controlled* processing of stereotypical gender associations is possible through more evaluative judgements encouraged by the longer SOA. While conservatives would generate a comparable N400 deflection to the violation of the semantic context to incongruent stereotype targets, liberals, when allowed to process more deeply the semantic context

of the incongruent stereotype target would find such association less implausible. This suggest for liberals, *not* violating the semantic context set-up by the gender prime resulted in a significant reduction or even absence of a N400 deflection. In other words, while conservatives continue to show a gender bias under *explicit* conditions, liberals would *not* have such explicit gender bias. This interpretation of the N400 differences is consistent with the behavioural data, since incongruent target judgements yielded significantly slower response times only among liberals in the long SOA condition.

What are the mechanism(s) allowing liberals to achieve such differential behavioral and electrophysiological outcomes? These findings suggest that, unlike conservatives, liberals were able to allot greater *cognitive control* resources in order to restrain the stereotypical response when SOA was increased in duration. Indirect evidence for involvement of cognitive control mechanisms come from recent electrophysiological and neuroimaging research in political and social neuroscience.

Firstly, the amplitude of event-related potentials reflecting neural activity associated with conflict monitoring- a main component of cognitive control operations- in the ACC, was reported greater for liberals compared to conservatives, consistent with increased sensitivity to cues for altering a habitual response pattern (Amodio et al, 2008). This is consistent with a study indicating that conflict monitoring accounts for variability in intergroup bias among low-prejudice participants (Amodio, Devine & Harmon-Jones, 2008).

Secondly, in a large sample of young adults, greater liberalism in self-reported political attitudes was associated with increased gray matter volume in the ACC– primarily involved in cognitive control. On the other hand, greater conservatism was

associated with increased volume of the right amygdala –a key structure involved in processing of emotional stimuli, particularly of negative valence (Kanai, Feliden, Frith, Rees, 2011), consistent with the hypothesis that conservatives are driven by a negativity bias (Hibbing, Smith & Alford, 2014).

Thirdly, other indirect evidence comes from a fMRI study of racial bias in which white or black faces were presented to Caucasian participants for either 30ms or 525ms, in order to identify neural components associated with *automatic* or *controlled* social evaluation. When the faces were presented the short duration, activation in the amygdala was greater for Black than for White faces. When the faces were presented at the long exposure, this difference was significantly reduced, and regions of *prefrontal cortex* associated with cognitive control and emotion regulation showed greater activation for Black than White faces, suggesting that controlled processes may modulate automatic social evaluation (Cunningham et al, 2004).

I propose that a similar involvement of cognitive control and emotional regulation processes may modulate stereotypical tendencies in gender stereotyping among people of a more progressive and open political creed, but only when slower, more deliberate decisions can take place at longer SOAs. In other words, when given more time to process the prime word (e.g. ‘Male’ or ‘Female’), liberals exhibited a diminished N400 deflection between congruent and incongruent word-pairs, implicating increased cognitive control in restraining a stereotypical response. This result was qualified by liberal’s greater uncertainty in classifying incongruent word-pairs, along with a greater increase in response time when determining if word-pairs were congruent or incongruent. In contrast, conservatives showed no significant differences in response time and accuracy in short and long time intervals between stimuli, suggesting a highly

consistent and efficient evaluation of stimuli.

In summary, my results are in-line with previous works suggesting that personality and cognitive mechanisms underlie individual differences in political ideology. This is the first study to empirically investigate the brain electrical responses of stereotype processing between groups of people separated by the divergence of political ideology. The results of this study do not imply any causal mechanism between political ideology and gender stereotyping, but rather it serves to expand on the emerging field of political neuroscience and show measurable psychological differences between liberals and conservatives. These findings, which are in-line with others merging cognitive neuroscience and political science (for a review, see Jost, Nam, Amodio, and Van Bavel, 2014), may inspire new future research to help our collective understanding of the psychological processes involved in political behavior and social decision making. In short, this study aimed to initiate the process of stripping gender bias of its camouflage, and allow researchers to uncover measurable psychological differences between political ideologies. I believe my results have successfully started this process.

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