Emotional Influence on Executive Function

by

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A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Science

Auburn, Alabama
August 3, 2019

Keywords: cognition, emotion, prefrontal, campaign advertisement, politics

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Abstract

The nature of the emotion-cognition interaction has recently been conceptualized as a dynamic interdependence with neuroanatomical and functional overlap. To date, however, the research on the impact of emotions on executive functioning has yielded mixed results and the exact relationship is not well understood. The present study sought to extend the emotion-cognition literature by examining the influence of emotion on two specific executive functions through a unique paradigm using political campaign advertisements in the form of video clips as the emotion stimulus. No significant physiological or behavioral differences were found between participants as a direct result of the stimuli. These findings represent an initial attempt to quantify the potential emotional/arousal-related impact of campaign advertisement videos on subsequent executive function.

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The 2016 U.S. Presidential Election was a particularly interesting point in both American politics and broadcast television as it relates to campaign advertisements. According to the Political Advertising Resource Center at the University of Maryland, 76% of the 2016 general election campaign television advertisements were character-based (i.e., questioning the character of the opposing candidate) – a number which dwarfs the 31% of character ads between 1952 and 2008 (Bhat, 2016). Considering the rather derisive nature of American party politics in the modern age, the use of negative campaign advertising should come as no surprise. It does, however, bring compelling questions to the forefront for social psychologists and neuroscientists to consider: to what extent are these advertisements influencing the electorate? Do emotional appeals through campaign advertisements influence rational decision making?

Before addressing the lingering questions, it is important to operationally define some of the terms which will be used for the purposes of the present study. First, the term "emotion" refers to the consistent and specific psychological responses triggered by neural regions in response to certain objects or situations (Damasio, 2000). A broadly accepted conceptualization of emotion proposes that affective experience is best explained along two dimensions – arousal and valence (Kensinger, 2004). Arousal refers to the intensity of both metabolic and neural activation associated with the presentation of an emotion-evoking stimulus (Lang, Bradley, & Cuthbert, 1998) and valence refers to the bipolar dimension on which an emotion falls – positive on one end, negative on the other (Osgood, Suci, & Tannenbaum, 1957). Research has demonstrated that psychophysiological measurements can detect both arousal and valence (Nummenmaa, Glerean, Hari, & Hietanen, 2014). Specifically, skin conductance response covaries (positively) with self-reported arousal, and heart rate is responsive to changes in affective valence (Lang et al., 1998). Given this definition of emotion, it is obvious that a physiological reaction in an important component of the unfolding response.

'Emotional appeals' refer to stimuli intended to elicit an emotional response (Brader, 2005). Advertising consultants and political scientists have recognized the central role of emotional appeal in the efficacy of political ads (Brader, 2005; Perloff & Kinsey, 1992). Politicians use emotional appeal in advertisements to stir the emotions, often fear-related, of their audience while delivering a political message (Brader, 2006). Though the academic literature on the topic of emotional appeal via campaign advertisements has been relatively sparse, it is probably safe to infer from their prevalence that marketing and advertising agencies find them to be quite useful.

To begin to understand how these emotional appeals may impact our rational decision-making ability, it is important to recognize the role of executive functions in the decision-making process. Decision-making is a complex task that requires a coordinated sequence of several underlying cognitive processes (Gleichgerrcht, Ibáñez, Roca, Torralva, & Manes, 2010). Recent research has demonstrated high scores on executive function tests are associated with more advantageous performance on a decision-making task (Delazer, Sinz, Zamarian, & Benke, 2007), suggesting a central role for executive functioning in the decision-making process. Due to its multidimensional nature (Banich, 2009), the present study will narrow the scope of "executive functioning" based both on anatomical/functional overlap and findings of factor analytic studies.

Executive Function

Executive function[1] is an umbrella term referring to a collection of top-down mental processes which help us coordinate our thoughts and plan actions in a goal-directed manner

[1] Executive function is also referred to as executive/cognitive control.

(Miller & Wallis, 2009). These functions are generally thought to involve the regulation of lower-level cognitive functions toward future-oriented behavior (Alvarez & Emory, 2006). Executive function is distinguishable from more automatic processes that do not require effortful thinking such as going on "autopilot" or simply following instinct (A. Diamond, 2013) and involve a host of abilities such as self-monitoring, planning, decision-making, hypothesis management, judgement, inhibiting prepotent responses, feedback management, and adapting behavior in response to ever-changing environments (Collette, Hogge, Salmon, & Van der Linden, 2006; Gunning-Dixon & Raz, 2003; H. Robinson, Calamia, Glascher, Bruss, & Tranel, 2014). Essentially, executive functions are what allow us to make flexible plans toward meeting a desired end goal and putting those plans into action. Three dimensions of executive function were identified in the neuropsychological literature through confirmatory factor analysis: working memory, inhibition, and shifting[2] (Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003; Miyake et al., 2000) and are generally agreed to be the core components therein (A. Diamond, 2013). Working memory and inhibition were chosen for the purposes of the present study.

Working Memory

As Baddeley (2003) states, working memory "refers to the temporary storage of information in connection with the performance of other cognitive tasks such as reading, problem solving, or learning". Working memory allows us to hold and manipulate information in our mind for later use. It also allows us to incorporate new information into existing plans, consider multiple alternatives before making a decision, and recognize relationships between objects or ideas (A. Diamond, 2013). For instance, working memory is what allows us to keep an

[2] "Working memory" also termed "updating" and "shifting" also referred to as "mental flexibility", "set shifting", or "mental set shifting" (Diamond, 2013).

itemized grocery list in mind when we go to the grocery store, or to remember the details of a news segment you watched earlier in the day while discussing it with friends.

Functional neuroimaging studies focusing on localizing working memory function have found that the prefrontal cortex is involved in tasks involving working memory (Braver et al., 1997; Cohen et al., 1994; McCarthy et al., 1994), specifically the dorsolateral prefrontal cortex (DLPFC). It should be noted that working memory function does not only rely on prefrontal regions. In a review by Andrés (2003), evidence from several studies of working memory revealed that patients with no history of prefrontal cortex damage have shown deficits on executive function and, conversely, patients with frontal lesions do not always show executive function deficits. Further, a meta-analysis by Owen, McMillan, Laird, and Bullmore (2005) identified convergent evidence across the neuroimaging literature for bilateral and medial posterior parietal cortex activation. In sum, the neuroanatomical foci of working memory function primarily involves a fronto-parietal network, with a heavy contribution from specific regions within the prefrontal cortex (i.e., DLPFC)(Curtis & D'Esposito, 2003). Additionally, fMRI studies of verbal working memory have indicated multiple activation foci within cerebellum across working memory and speech tasks (Durisko & Fiez, 2010).

One commonly used measure of working memory capacity, the *N*-back task, requires subjects to watch a stream of items and identify repetitions in the sequence *n* trials back, where *n* represents a pre-designated number (Baddeley, 2003; Owen et al., 2005). The task requires monitoring, manipulating, and updating remembered information and is thus presumed to place heavy demand on working memory-related processes (Owen et al., 2005). Though the construct validity of the task has recently been called into question, the *N*-back task has face validity as a measure of working memory as it requires participants to maintain and update a dynamic rehearsal set while responding to the items of the task (Kane, Conway, Miura, & Colflesh, 2007).

Inhibition

Response inhibition, or inhibitory control, refers to the ability to halt behavioral responses which are inappropriate or undesired in the present context (Liddle, Kiehl, & Smith, 2001). It is a crucial ability in adaptive regulation of behavior as it allows for flexible responses to changing task demands (Goldstein et al., 2007). Inhibitory control is an essential component of response selection processes which contribute to precise and accurate performance (Roberts, Robbins, & Weiskrantz, 1998). The ability to inhibit an irrelevant response which is not appropriate in a given context is an important component in normal functioning and a central element of executive control (Liddle et al., 2001; Verbruggen & Logan, 2008). An example of response inhibition might be stopping yourself from crossing an intersection, signaled by the "Walk" light, when an unaware driver proceeds through a red light.

Garavan, Ross, and Stein (1999) localized the majority of activation in a response inhibition task to the inferior frontal gyrus (Brodmann Area (BA) 10), middle frontal gyrus (BA 9), and the inferior parietal lobe (BA 40) in a study using functional magnetic resonance imaging (fMRI). Notably, the authors also found the activation in the prefrontal area to be lateralized to the right hemisphere. Like working memory function, neuroanatomical correlates of response inhibition reveal a distribution of activation depending on the particular task demands involved. A quantitative meta-analytic study of neuroimaging studies found evidence for distributed activation in the pre-supplementary motor area, the left fusiform gyrus, as well as the previously implicated prefrontal (BA46) and parietal areas (Simmonds, Pekar, & Mostofsky, 2008a). The anterior cingulate cortex has also long been implicated in inhibitory processes (Casey et al.,

1997) and recent studies have identified some inhibitory control function to the parietal lobe (i.e., bilateral intraparietal sulcus and bilateral temporoparietal junction) (Kolodny, Mevorach, & Shalev, 2017). Notably, in a review of inhibition studies, Aron, Robbins, and Poldrack (2004) found support for this function to be localized to the right inferior frontal cortex alone, supported by studies utilizing human lesion-mapping.

One paradigm used to measure response inhibition in an experimental setting is the Go/No-Go task which typically requires participants to inhibit or execute a motor response when prompted by a signal ("no-go" for inhibition and "go" for execution of the response) (Goldstein et al., 2007). There are far more 'go' trials than 'no-go' trials, enticing the participant into a prepotent motor response. The Go/No-Go task has been used extensively in both clinical and animal research settings in efforts to assess the neural correlates of response inhibition (Simmonds, Pekar, & Mostofsky, 2008b), though, a gap in the research exists in relation to the effects of affective states on inhibitory function (Mitchell & Phillips, 2007). The advantage of the Go/No-go paradigm in comparison with other tests of inhibition lies in its simple format. That is, the Go/No-go task minimizes other cognitive and behavioral processes involved with other tests of response inhibition such as stimulus-response conflict induced by the Stroop task, for instance (Simmonds et al., 2008a). Given these characteristics, the Go/No-Go task is ideally suited for investigations of executive function.

Emotion and Executive Function Interaction

Only a few decades ago a debate ensued over the independence or interdependence of cognition and emotion. A heavily cited study by Kunst-Wilson and Zajonc (1980) provided evidence that affective discriminations (e.g., like or dislike ratings) could be made without substantial participation of the cognitive system – a finding which supported the idea that affect was primary to, and separate from, cognitive processes (i.e., independence). In the following year, Bower (1981) described two effects which rely heavily on the integration of cognition and emotion/affect (i.e., the mood-congruity effect and mood-state-dependent retention) and argued that emotional effects could be described in terms of cognitive processing (i.e., interdependence). Evidence in the neuroscience literature tends to support a view closer to Bower's – a view of an intricate and dynamic interplay of emotion and cognition that highlights the functional connectivity between the areas which were once thought to be more distinct (Pessoa, 2008). For instance, investigation of the effect of emotional content – in this case, emotional faces – showed that both fearful and happy face pictures improved response inhibition relative to neutral face pictures (Pessoa, Padmala, Kenzer, & Bauer, 2012), suggesting that emotion-related signals have a direct impact on cognitive processes.

In a review of cerebral blood flow studies using positron emission tomography (PET), Drevets and Raichle (1998) observed a reciprocal relationship in blood flow between emotion-processing areas and areas specialized for cognitive processes suggesting that emotional states and cognitive processes may interact with one another. This led to a conceptual framework in which prefrontal regions (i.e., cognitive centers) were thought to inhibit limbic regions (i.e., emotional hubs). Although the exact nature of the relationship between these regions is unknown, there is a plethora of evidence suggesting a reciprocal relationship. Indeed, more recent neuroimaging studies have revealed highly specific anatomical evidence of cognition-emotion integration in the prefrontal and orbitofrontal cortices (Beer, John, Scabini, & Knight, 2006; Goldstein et al., 2007; Gray, Braver, & Raichle, 2002; J. L. Robinson, Laird, Glahn, Lovallo, & Fox, 2010). For example, in a study of the impact of emotion on decision making, researchers found that increased impulsive decision making occurred under high-arousal emotional states, regardless of valence, compared to neutral-arousal emotional states (Sohn et al., 2015).

Physiological Measures of Emotion/Arousal and Cognitive Processes

Other research has shown that the manipulation of autonomic states using subliminal affective primes (i.e., the word ANGER) impaired the speed of lexical decision making and the degree to which individuals were susceptible to the manipulation was correlated to the magnitude of increased systolic blood pressure evoked by the prime (Garfinkel et al., 2016), suggesting a central role for the disruption of cognitive processes by emotion/arousal induced physiological activity. Research has also indicated that brain areas implicated in both emotion and attention are involved in the generation and representation of peripheral, sympathetic skin conductance responses (Critchley, Elliott, Mathias, & Dolan, 2000). Additionally, heart rate variability has been identified as a unique emotion regulation measure, as it provides information regarding both the parasympathetic and sympathetic nervous system (Appelhans & Luecken, 2006). Together, these data highlight the abundance of support for a formidable relationship between cognitive and emotional centers in the brain, which both generate physiological changes through the autonomic nervous system that can be assessed by non-invasive techniques (for a review see (Kreibig, 2010)).

Dorsolateral Prefrontal Cortex and Emotion-Related Processes

The role of the DLPFC as a strict cognitive control region has been called into question by studies utilizing game theoretic paradigms like the Ultimatum Game (Sanfey, Rilling, Aronson, Nystrom, & Cohen, 2003). The Ultimatum Game is a game of two players; one (the proposer) is endowed with a sum of money and is tasked with splitting it with another player (the responder). The responder, in turn, can either accept or reject the sum offered by the proposer. If the sum is accepted, the money is split as proposed; if the sum is rejected, neither player receives the money. Ideally, this particular game produces conflict between reason and emotion, as participants must decide between accepting or rejecting an unfair offer. Neuroimaging data from experimental manipulations of this paradigm show that the DLPFC, the anterior cingulate cortex, and bilateral insula show greater activation in response to unfair offers (Sanfey et al., 2003). Further supporting the idea that the DLPFC may play a role in affective processes, low-frequency repetitive transcranial magnetic stimulation of the right DLPFC (but not the left DLPFC) significantly reduced subjects' willingness to reject intentionally unfair offers in the Ultimatum Game (Knoch, Pascual-Leone, Meyer, Treyer, & Fehr, 2006), suggesting a reduction of an anger impulse (Tassy et al., 2011). Moreover, a meta-analytic study of the overlapping neural circuitry involved in psychiatric disorders (i.e., schizophrenia, bipolar and unipolar depression, substance use disorders, and anxiety disorders) found common patterns of disruption in brain areas corresponding to the cognitive control network including the left prefrontal cortex, right insula, ventrolateral prefrontal cortex, right intraparietal sulcus, and anterior midcingulate cortex (McTeague et al., 2017). Furthermore, the DLPFC has been shown to exhibit hypoactivity in individuals experiencing major depressive disorder (Fitzgerald et al., 2006), and is the therapeutic target for transcranial magnetic stimulation as well as transcranial direct current stimulation (Salehinejad, Ghanavai, Rostami, & Nejati, 2017) resulting in significant improvements in both executive function and depression scores.

Finally, the DLPFC has also been implicated in emotion regulation processes, suggesting a regulatory influence of the cortex on lower, subcortical regions typically involved in emotion/affect related processing (Davidson, Putnam, & Larson, 2000; Diekhof, Geier, Falkai, & Gruber, 2011; Ochsner, Silvers, & Buhle, 2012). Emotion regulation refers to the processes by which a person influences which emotions they have, when they have them, and how they experience these emotions (Gross, 1998). Taken together, the evidence above suggests that the DLPFC is an important component in both cognition and emotion/affect-related processing.

Dorsolateral Prefrontal Cortex and Executive Function

Working Memory. An abundance of neuroscientific literature implicates the DLPFC in both emotional and cognitive processing. As previously discussed, the DLPFC is proposed to play a role in tasks of working memory. Notably, the role of the DLPFC in working memory seems to be particularly susceptible to affect-related processing. A functional neuroimaging study of the human prefrontal cortex showed maintenance-related working memory activity in the DLPFC was modulated by emotional valence. More specifically, when participants were asked to remember emotional or neutral pictures, the pleasant pictures increased activity and improved active maintenance when compared to neutral pictures, and unpleasant pictures decreased activity and diminished active maintenance (Perlstein, Elbert, & Stenger, 2002a). The function of the DLPFC, however, appears to show hemispheric differences in its contribution to working memory function. A study of working memory in human brain lesion patients found the left DLPFC to be necessary for the manipulation of information during working memory tasks as opposed to the right, which was found to be critical for more broad reasoning tasks less related to working memory (Barbey, Koenigs, & Grafman, 2013). It is also worth noting that the right DLPFC's contribution to working memory has been shown to be diminished by emotional stimuli (Perlstein, Elbert, & Stenger, 2002b), suggesting that it may be particularly sensitive to emotion.

Inhibition. Activation of the DLPFC has also been found during tasks of inhibition. Studies of cognitive control have reported a linear relationship between DLPFC activation and performance on top-down cognitive control tasks (Kerns et al., 2004; MacDonald, Cohen, Stenger, & Carter, 2000). Extending this literature, a neuroimaging study of an inhibition task found DLPFC activation during the management of irrelevant stimuli and the inhibition of prepotent responses (Blasi et al., 2006). The DLPFC, however, may in fact be divisible into functionally distinct sub-regions. Based on functional neuroimaging studies, Banich (2009) proposed a model of DLPFC function in which the posterior regions impose top-down attentional control toward task-relevant processes. That is, the posterior regions activate to inhibit the processing of task-irrelevant stimuli. Banich's model further delineates the DLPFC sub-regions by suggesting the mid-DLPFC may be responsible for the selection of task relevant stimuli. Indeed, in line with the predictions of the model, neuroimaging data suggests sub-regions of the DLPFC are responsible for different aspects of inhibition-related function (Warren et al., 2013). The anterior cingulate cortex has been identified as the region which recruits the DLPFC to resolve conflict between simultaneously active, competing representations (for a review, see (Botvinick, Cohen, & Carter, 2004; Carter & Van Veen, 2007)). Given the unique position of anterior cingulate – situated in the medial wall of both cerebral hemispheres, above and adjacent to the corpus callosum – the anterior cingulate cortex is anatomically connected to both cognitive regions (i.e., prefrontal cortex) and the limbic system (Stevens, Hurley, & Taber, 2011), perhaps providing a neuroanatomical pathway for the disruption of cognitive processes by emotional arousal. Following these findings, it is hypothesized that emotional arousal may diminish executive functioning through the DLPFC.

Current Study

The current study sought to examine the effects of emotion induction on executive function through the use of a novel paradigm involving political campaign advertisements. Since the early 1990's, researchers have noted the increasing hostility of political campaigns and the emergence of negative (or attack) advertising as a hallmark of these campaigns (Ansolabehere, Iyengar, Simon, & Valentino, 1994). Little research has focused on the effects these emotionally-charged, negative campaign advertisements may have on subsequent executive function in viewers. Notably, a recent neuroimaging study explored political advertisements and the subsequent effects on self-reported affinity ratings and found that participants who showed stronger DLPFC activation after viewing a negative campaign videos lowered their ratings of the candidate they originally supported more than those with weaker activations. Further, the authors suggest this activation may be consistent with the participants' processing of the negative information of their candidate, which parallels, to some extent, the literature on the DLPFC's role in top-down attentional control and the selection of task-relevant stimuli (Kato et al., 2009). The present study sought to extend the literature by examining the impact of emotionally charged stimuli on two executive functions previously implicated in emotional processing.

Hypotheses

Based on our review of the scientific literature as it relates to emotion-cognition interactions, I expected to find behavioral differences in executive functioning task data (working memory and inhibition) following the campaign advertisement viewing within-subjects. Specifically, I hypothesized that:

Hypothesis 1. Working memory function, as assessed by an *N*-back task, would decline following the campaign advertisement stimulus.

Hypothesis 2. Inhibition response function, as assessed by a Go/No-Go task, would decline following the campaign advertisement stimulus.

Hypothesis 3. Physiological data will show elevated sympathetic arousal in response to the Trump and Hillary conditions in comparison to the neutral condition.

Methods

The study consisted of three individual phases – stimulus validation, prescreening, and experiment. The first phase included development of the video stimuli and a pilot study to ensure the stimuli could produce the desired effect before inviting participants to the laboratory. During the second phase of the study, subjects were prescreened to identify any current existing medical issues, handedness, and psychological issues including PTSD, depression, and anxiety with validated measurements for each which are described in detail below. Finally, the third phase of the study includes the in-lab experiment in which participants were fitted with physiological recording devices to assess heart rate variability, respiratory sinus arrhythmia, and skin conductance responses while they participated in the behavioral experiment. All study procedures were approved by the Auburn University Institutional Review Board (Protocol #17-036 MR 1703).

Phase 1: Video Stimulus Validation

In order to validate the video stimuli to be used in the present study, a pilot survey was conducted with a sample (N = 118) of Auburn University undergraduate students through Auburn University's cloud-based participation system (Sona Systems). Before participants were allowed to continue the study, they were asked to review the information letter (Appendix A) and provide their consent, as per Auburn University Institutional Review Board, Protocol #17-036 MR 1703. Participants were asked to view each of the three video stimuli and rate their level of arousal on a reduced version of the Pleasure Arousal Dominance Scale (Appendix B) which included the six items (Cronbach's α = .938) which directly assess arousal on a one-to-seven

Likert scale. Mean arousal level was assessed for the "neutral" ($M \pm SD = 1.97 \pm 0.93$), "anti-Trump" ($M \pm SD = 4.55 \pm 1.04$), and "anti-Hillary" ($M \pm SD = 4.44 \pm 1.17$). A repeated measures analysis of variance (ANOVA) with mean arousal as the within-subjects factor on these ratings yielded significant variation among conditions, $F(2 , 353) = 227.887$, $p < .001$, $\eta^2 = .565$ (Figure 1). A post-hoc test for multiple comparisons (Tukey's HSD) showed that both the anti-Trump and anti-Hillary videos differed significantly ($p < .001$) with the neutral video but did not differ significantly from one another ($p = .719$).

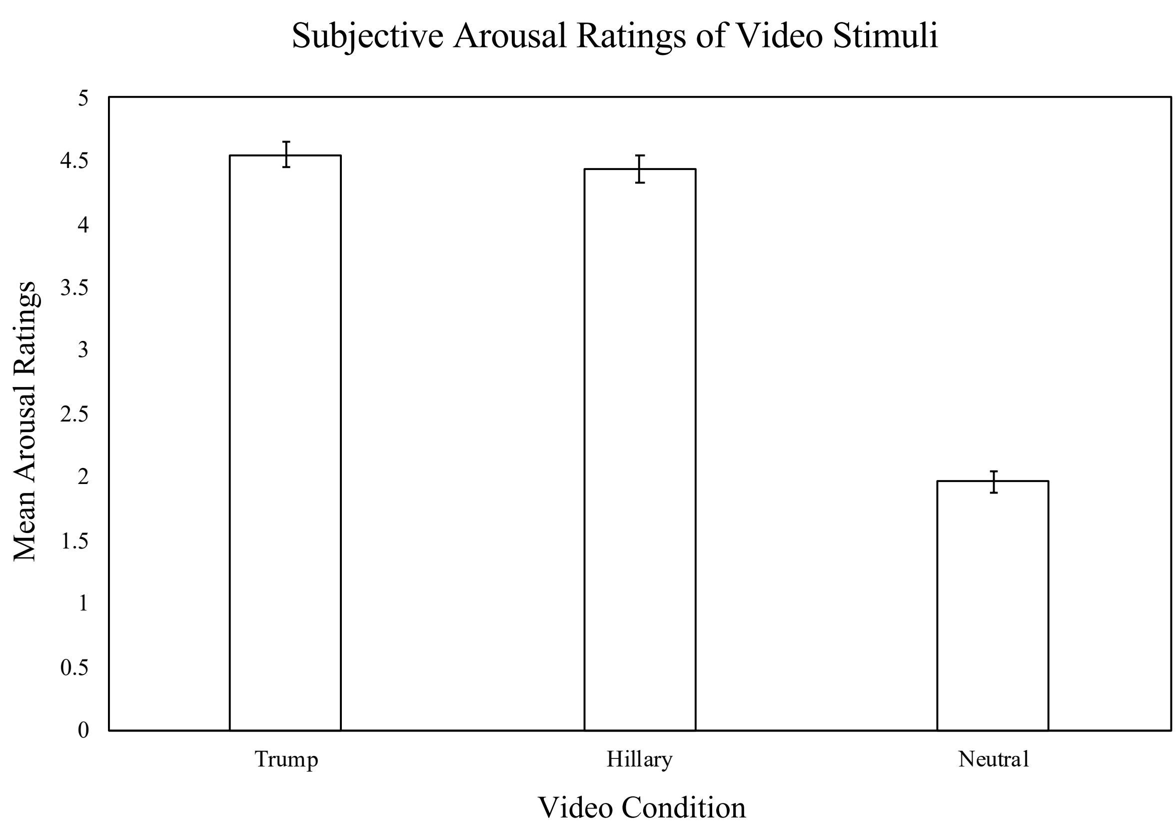

Figure 1. Pilot Study Arousal Ratings. Subjects viewed each video condition and rated their level of arousal on 6 items from the Pleasure Arousal Dominance Scale with standard error for the error bars.

Phase 2: Prescreening

Before inviting participants to the laboratory for the experiment, I first developed an online prescreening study to assess potential participants on a number of variables, approved by the Auburn University Institutional Review Board, Protocol #17-036 MR 1703. Participants in the prescreening study were first given an Informed Consent in the form of an information letter which they had to endorse followed by questions on basic demographics (i.e., age, sex, ethnicity, and racial identification), personality dimensions as assessed by the Big Five Inventory (John & Srivastava, 1999), political party affiliation, and authoritarian attitudes as assessed by the Right-Wing Authoritarianism scale (Altemeyer, 2007), a handedness questionnaire, and medical history (i.e., head trauma, stroke, epilepsy, seizures, neurological surgery, other neurological problems, cardiovascular disease, psychiatric illness, and prescription medication). Additionally, all participants were asked to complete three clinical assessments which were to be used as exclusionary measures. First, participants were given the PCL-5 (Weathers et al., 2013), a post-traumatic stress disorder (PTSD) checklist that assesses both the presence and severity of PTSD symptoms. Next, participants were given the Beck Depression Inventory II (Beck, Steer, & Brown, 1996) – a psychometric test for assessing severity of depressive symptoms. Finally, participants were asked to complete the Beck Anxiety Inventory (Beck, Epstein, Brown, & Steer, 1988) in order to assess the prevalence and severity of symptoms of anxiety. Cutoff scores based on clinical significance of moderate to severe were established for entrance into the third phase of the study – 28, 16, and 16 for the PCL-5, BDI-II, and BAI, respectively. Individuals who scored below the established cutoffs were invited to phase three. All questions included in the prescreening survey are located in Appendix C. Two-hundred eighty-three (230 females, 53 males, $M \pm SD = 19.9 \pm 2.33$ years old) participants completed the prescreen. Of these, forty-two participants met criteria and accepted the invitation to Phase 3 of the experiment (described below).

Phase 3: In-Lab Experiment

Those subjects who met the criteria and accepted the invitation took part in the third and final phase of the study. During the third phase, participants were invited to the lab, given the Informed Consent/Information Letter (Appendix A), and asked to provide their signature if they felt comfortable moving forward with the study. After informed consent was obtained, all participants went through a skin preparation procedure. First, participants were asked to remove any items (e.g., jewelry, watches, wristbands) they were wearing. Next, each participant's wrist was prepared with an alcohol wipe and a mild abrasive gel with an abrasive, disposable cotton cloth on each of their wrists to ensure clean contact with the electrodes. Following the skin preparation, each participant was fitted with four electrodes – two skin conductance electrodes placed on the index and middle finger and one electrocardiogram electrode on each wrist - and a respiration belt fitted just below the ribs. Participants were asked to sit calmly while the researcher confirmed that the data are being recorded accurately. Once confirmed, the door to the lab was closed and the experiment began.

Subjects. Forty-two Auburn University undergraduate students completed the study (36 females, 6 males, $M \pm SD$ = 19.97 ± 1.09 years old, 81% Caucasian, 25 Republican, 14 Democrat, 2 Libertarian, 1 Green Party). Subjects were prescreened to identify any current or existing medical issues, handedness, and psychological issues including PTSD, depression, and anxiety with validated measurements for each. Subjects were given class credit for their participation. The study was conducted at Auburn University and was approved by the university Institutional Review Board, Protocol #17-036 MR 1703.

Materials. Visual/auditory stimuli were presented as three two-minute video clips – two character-based attack ads taken from the 2016 Presidential Election season (representing the Republican candidate Donald Trump and Democrat candidate Hillary Clinton, respectively) and a third, neutral clip sourced from a CSPAN political hearing on environmental regulations. Clips were sourced from YouTube and have been shown on national/local television. All clips were validated in Phase 1.

Behavioral Tasks. Participants were given two classic neuropsychological behavioral tasks to assess different components of executive function: working memory and inhibition.

N-Back Task.

Working memory function was assessed with a 1-back task designed within the E-Prime Psychology Software Tools package, version 3. The task consisted of 80 trials (stimulus presentation length = 1000ms, inter-stimulus interval = 500ms) which had a runtime of exactly two minutes. The stimulus set included colored shapes and participants were asked to hit "1" or "3" on the keyboard placed in front of them, corresponding to identification of "same" or "different", respectively, when compared to the previous trial. The 1-back task was given a total of five times – one practice, one baseline, and one after each stimulus presentation.

Go/No-Go Task.

Inhibition function was assessed with a Go/No-Go task designed within the E-Prime Psychology Software Tools package, version 3. The task consisted of 80 trials - 71 "go" trials and 9 "no-go" trials (stimulus presentation length = 1000ms, inter-stimulus interval = 500ms) - and had a runtime of exactly two minutes. The stimulus set included the letters "x" and "y" and participants were asked to hit "1" on the keyboard placed in front of them if the stimulus presented was incongruent with the previous trial (e.g., hit "1" if "y" follows "x") and refrain from striking the keyboard if the stimulus presented was congruent with the previous trial (e.g., hit nothing if “x” follows “x”).

Physiological measurement. Electrodermal activity (EDA), electrocardiogram (ECG), and respiration were measured through the duration of the experiment as simultaneous measures of sympathetic and parasympathetic nervous system arousal. A BIOPAC MP150 system was used with an ECG MRI-compatible amplifier (BIOPAC product #ECG100C-MRI), an EDA MRI-compatible amplifier (BIOPAC product#EDA100C-MRI), and a respiration amplifier (BIOPAC product number RSP100C) with all corresponding cables to and from the amplifier being MRI-compatible (BIOPAC product numbers MECMRI-BIOP and MECMRI-TRANS). Data was collected on an HP 6570b notebook PC with Windows 7 Professional, AcqKnowledge BIOPAC software, mobile Intel HM76 chipset, 8GB 1600MHz DDR3 SDRAM, and a 500GB 7200rpm SATA hard drive. In total, participants wore 4 electrodes (2 ECG, 2 EDA) and a respiration belt.

Two galvanic skin response-recording electrodes with leads to the EDA amplified were prepared with isotonic gel and placed on the last joint of the middle and ring fingers of the nondominant hand. A respiration belt with a lead to the respiration amplifier was fitted to each participant just below the ribs. Electrodes with leads to the ECG amplifier were prepared with gel and applied to both wrists. EDA, ECG, and respiration were measured using BIOPAC-specified safety and measurement standards. The data recorded from the three physiological measures were analyzed to determine the extent to which physiological arousal stimulated by the campaign advertisement contributed to subsequent executive function performance. To characterize the physiological effects of the campaign advertisement stimuli, I assessed heart rate variability (HRV), respiratory sinus arrhythmia (RSA), and skin conductance response for each participant and compared mean measurements of each across conditions. All data were analyzed using the BIOPAC AcqKnowledge Data Acquisition and Analysis Software package. Before the analysis, the skin conductance waveform was resampled to 62.5 Hz and corrected using a low pass 10 Hz filter – both steps were taken to remove noise artifacts from the collected data. Both the HRV and RSA data were analyzed using the 'Multi-Epoch Spectral' analysis with user-generated focus areas over the blocks of interest. HRV was assessed by calculating the sympathetic-vagal ratio averaged over the duration of the stimulus presentation blocks.

Experimental paradigm. Following the application of the physiological recording devices, participants were given a pretest of two tasks (two minutes each) used to assess executive function. Working memory was assessed by an *N*-back (1-back) task and inhibition was assessed with a Go/No-Go task. The order of the tasks was determined based on the involvement of the DLPFC in each. According to the literature, the DLPFC plays a major role in modulating working memory function and is involved with the other functions to the extent that they rely on working memory (Berman et al., 1995; Curtis & D'Esposito, 2003; Mostofsky et al., 2003). Upon completion of the practice tasks, participants completed the same tasks again for a baseline measure of performance. The end of the baseline behavioral tasks constitutes the beginning of Block 1. Block 1 begins with presentation of one of the three randomly assigned video clips – random assignment was used to control for potential order effects. Following the presentation of each video clip, participants completed the two behavioral tasks consecutively, followed by a six-minute break period before beginning the next block (Figure 2).

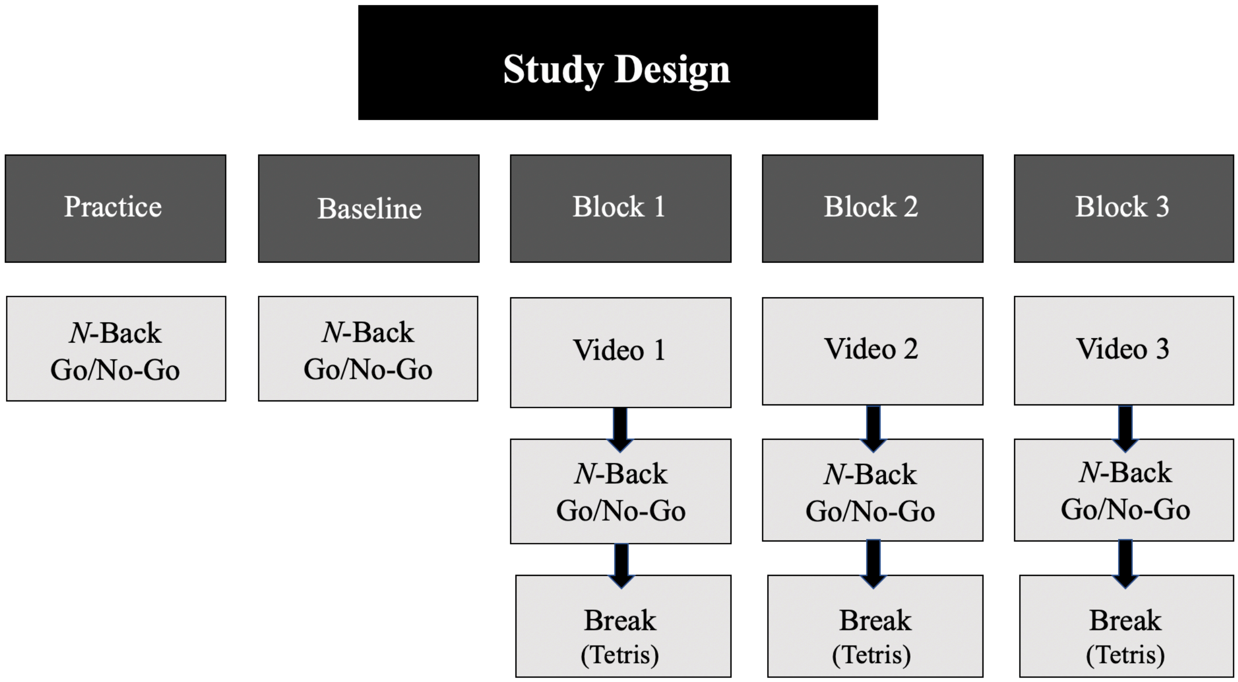

Figure 2. Study Design. This figure illustrates the design of the study. Order was randomized among participants. Videos were either neutral in nature (i.e., 'Neutral'), attack advertisements of Donald Trump (i.e., 'Trump'), or attack advertisements of Hillary Clinton (i.e., 'Hillary).

During the first minute of the break, participants were asked to complete the Pleasure Arousal Dominance scale (Appendix B). During additional five minutes, participants were asked to play Tetris on an iPad which I provided for them.

Behavioral Analysis and Results

Hypothesis 1: Working memory function, as assessed by an N-back task, would decline following the campaign advertisement stimulus, regardless of political affiliation.

To characterize the potential effect of the campaign advertisement stimuli on subsequent working memory performance, I performed a repeated measures ANOVA within IBM's SPSS Statistics (version 24) on the overall accuracy scores for the N-back task which immediately followed the presentation of the advertisement stimuli as the within-subjects factor. Before running the ANOVA, descriptive statistics were examined to determine normality and to assess for outliers. I eliminated outliers which were more than three times the interquartile range from a quartile – noted as "extreme outliers" in SPSS (i.e., Tukey's Fences). For the N-back accuracy data, three participants' data were rejected on the basis of the Tukey's Fences approach. Analyses revealed no significant differences in mean scores of N-back accuracy between conditions, $F(2, 76) = .433$, $p = .65$, $\eta^2 = .011$ (Table 1). Mean accuracy scores across condition exceeded 95% reflecting a ceiling effect, making detection of any differences which might have arisen as a byproduct of the campaign advertisement stimuli unlikely. In addition to assessing the overall accuracy scores for each N-Back, I further analyzed the mean reaction time data – the amount of time, on average, it took for a participant to respond to the trials within each N-Back block. Before running the ANOVA, descriptive statistics were examined to determine normality and to assess for outliers – no outliers were present. While the repeated measures ANOVA with *N*-Back reaction time as the within-subjects factor failed to reach significance, $F(2, 82) = 1.202$, $p = .306$, $\eta^2 = .028$ pairwise comparisons (Least Significant Difference) revealed a significant difference between the mean reaction times for the Trump and Neutral conditions (532.14 ± 74.01 milliseconds vs. 546.14 ± 76.77 milliseconds, respectively), $p = .034$ (Table 2 & 3, Figure 3).

Table 1

N-Back Accuracy Descriptive Statistics

	Mean	*SD*	*N*
Trump	0.959	0.038	39
Hillary	0.961	0.037	39
Neutral	0.955	0.039	39

Note. Each condition (i.e., Trump, Hillary, Neutral) refers to the N-Back task which immediately followed the presentation of the respective video stimulus.

Table 2

N-Back Reaction Time Descriptive Statistics

	Mean	*SD*	*N*
Trump	532.14	74.01	42
Hillary	543.27	92.51	42
Neutral	546.14	76.77	42

Note. Each condition (i.e., Trump, Hillary, Neutral) refers to the N-Back task which immediately followed the presentation of the respective video stimulus.

Table 3

Pairwise Comparisons for N-Back Reaction Time

(I) NBRT	(J) NBRT	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval	
					Lower Bound	Upper Bound
Trump	Hillary	-11.127	10.239	0.283	-31.804	9.55
	Neutral	-14.002*	6.391	0.034	-26.909	-1.096
Hillary	Trump	11.127	10.239	0.283	-9.55	31.804
	Neutral	-2.876	11.283	0.8	-25.661	19.91
Neutral	Trump	14.002*	6.391	0.034	1.096	26.909
	Hillary	2.876	11.283	0.8	-19.91	25.661

Based on estimated marginal means

a. Adjustment for multiple comparisons: LSD (equivalent to no adjustments).

Note. Each condition (i.e., Trump, Hillary, Neutral) refers to the N-Back task which immediately followed the presentation of the respective video stimulus.

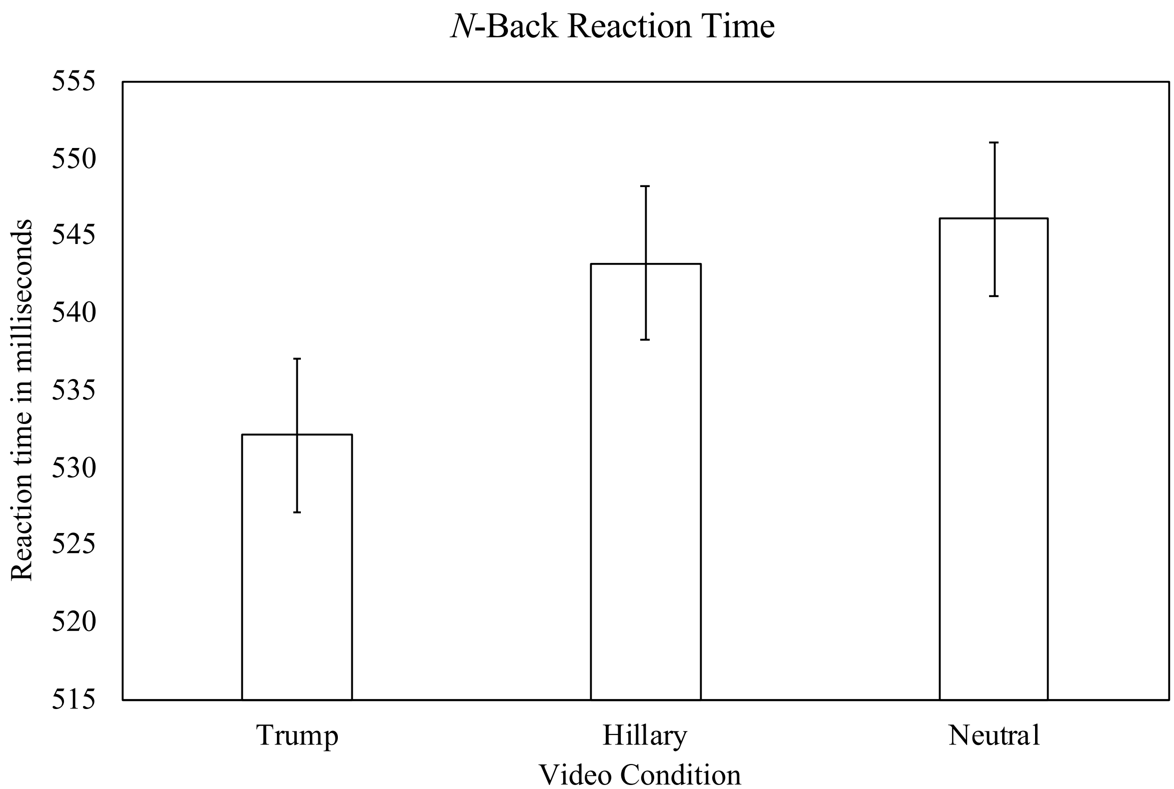

Figure 3. N-Back Reaction Time. This figure illustrates the mean reaction time for *N*-Back across conditions using standard error for the error bars.

Hypothesis 2: Inhibition response function, as assessed by a Go/No-Go task, would decline following the campaign advertisement stimulus, regardless of political affiliation.

In order to assess the potential effect of the campaign advertisement stimuli on inhibitory response function, I performed a repeated measures ANOVA on the overall accuracy scores for all participants on the Go/No-Go tasks which immediately followed the presentation of the advertisement stimuli. Before running the ANOVA, I performed descriptive statistics to assess normality and to check for outliers; subsequently, outliers surpassing the Tukey's Fences approach were eliminated. For the Go/No-Go accuracy data, three participants' data were rejected on the basis of the Tukey's Fences approach – inspection of the data in these outliers indicated that participants did not complete the task appropriately for at least one of the three post-video conditions. Additionally, upon examination of the data, it became evident that a sizable portion of the participants completed the task incorrectly – rather than treating the Go/No-Go as a continuous task, these participants treated the trials as pairs (i.e., responding every other trial). The seventeen participants who incorrectly completed the task as described above were excluded from further analyses. Repeated measures ANOVA with Go/No-Go accuracy as the within-subjects factor of the remaining sample ($N = 22$) revealed no significant differences in mean scores of Go/No-Go accuracy between conditions, $F(2,42) = 1.954$, $p = .154$, $\eta^2 = .085$ (Table 4). As with the N-back scores, the Go/No-Go accuracy scores were exceedingly high (in this case, all above 93%), indicating a likely ceiling effect, making any potential effect of the campaign advertisement stimuli virtually undetectable. Repeated measures ANOVA with Go/No-Go reaction time as the within-subjects factor revealed no significant differences between conditions, $F(2,48) = .513$, $p = .602$, $\eta^2 = .021$ (Table 5).

Table 4

Go/No-Go Accuracy Descriptive Statistics

	Mean	*SD*	*N*
Trump	0.949	0.027	22
Hillary	0.939	0.057	22
Neutral	0.956	0.026	22

Note: Each condition (i.e., Trump, Hillary, Neutral) refers to the Go/No-Go task which immediately followed the presentation of the respective video stimulus.

Table 5

Go/No-Go Reaction Time Descriptive Statistics

	Mean	*SD*	*N*
Trump	374.31	43.01	25
Hillary	377.55	45.75	25
Neutral	383.55	41.49	25

Note. Each condition (i.e., Trump, Hillary, Neutral) refers to the Go/No-Go task which immediately followed the presentation of the respective video stimulus.

Physiological Analysis and Results

Hypothesis 3: Physiological data will show elevated sympathetic arousal in response to the Trump and Hillary conditions in comparison to the neutral condition.

To characterize the physiological effects of the campaign advertisement stimuli, I assessed heart rate variability (HRV) using sympathetic/vagal ratio, skin conductance response, and respiratory sinus arrhythmia (RSA) for each participant and compared mean measurements of each across conditions. Given the lack of normality in the sympathetic/vagal ratio data (Table 6), an ANOVA was determined to be inappropriate and a Sign Test was used to assess the data. The Sign Test of the sympathetic/vagal ratio revealed no significant differences between conditions (Table 7).

Table 6

Sympathetic/Vagal Ratio Descriptive Statistics

	Mean	*SD*	*N*
Trump	4.2744	5.636	42
Hillary	4.6252	6.429	42
Neutral	9.1996	27.48	42

Note. Each condition (i.e., Trump, Hillary, Neutral) refers to the Sympathetic/Vagal Ratio measured during the stimulus presentation.

Table 7

Sympathetic/Vagal Ratio Sign Test

	Hillary - Trump	Neutral - Trump	Neutral - Hillary
Z	0	-1.389	-0.772
Asymp. Sig. (2-tailed)	1	0.165	0.44

Note: Each condition (i.e., Trump, Hillary, Neutral) refers to the Sympathetic/Vagal Ratio measured during the stimulus presentation.

Skin conductance responses were assessed in two different categories - by mean micro siemens (*mS*) over the duration of the stimulus presentation block and the sum of event counts (i.e., skin conductance responses) during each stimulus presentation block. Before running the ANOVA, I checked descriptive statistics (Table 8) for outliers and eliminated those that failed to meet the previously stated criteria for the Tukey's Fences approach. In addition to the single outlier removed on the basis of Tukey's Fences, the skin conductance data for one subject was excluded due to technical issues during data collection. Repeated measures ANOVA with mean skin conductance as the within-subjects factor revealed no significant differences for the mean *mS* level, $F(2,78) = 1.016$, $p = .367$, $\eta^2 = .025$.

Table 8

Mean Skin Conductance Descriptive Statistics

	Mean	*SD*	*N*
Trump	14.301	4.41	40
Hillary	13.939	4.79	40
Neutral	14.322	4.84	40

Note: Each condition (i.e., Trump, Hillary, Neutral) refers to the Mean Skin Conductance Response measured during the video stimulus presentation.

Further, after checking the descriptive statistics (Table 9) for the skin conductance event count for outliers and finding none, repeated measures ANOVA with skin conductance event count as the within-subjects factor revealed no significant differences in skin conductance event count, $F(2,80) = .244$, $p = .784$, $\eta^2 = .006$.

Table 9

Skin Conductance Event Count Descriptive Statistics

	Mean	*SD*	*N*
Trump	5.78	2.95	41
Hillary	5.61	2.62	41
Neutral	5.98	2.87	41

Note: Each condition (i.e., Trump, Hillary, Neutral) refers to the Skin Conductance Event Count measured during the video stimulus presentation.

Finally, after checking the descriptive statistics for RSA (Table 10) and finding no outliers based on the previously stated criteria, repeated measures ANOVA revealed no significant difference between the mean RSA values between conditions, $F(2,82) = 1.512$, $p = .226$, $\eta^2 = .036$. However, a pairwise comparison (Least Significant Difference) of the conditions revealed differences approaching significance between the Trump and Hillary conditions (11.68 ± 1.94 vs. 12.26 ± 1.78), $p = .052$ (Table 11, Figure 4).

Table 10

Respiratory Sinus Arrhythmia Descriptive Statistics

	Mean	*SD*	*N*
Trump	11.681	1.94	42
Hillary	12.257	1.78	42
Neutral	12.003	1.99	42

Note: Each condition (i.e., Trump, Hillary, Neutral) refers to the Respiratory Sinus Arrhythmia measured during the video stimulus presentation.

Table 11

Pairwise Comparisons for Respiratory Sinus Arrythymia

(I) RSA	(J) RSA	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval	
					Lower Bound	Upper Bound
Trump	Hillary	-0.575	0.288	0.052*	-1.157	0.006
	Neutral	-0.321	0.361	0.379	-1.051	0.409
Hillary	Trump	0.575	0.288	0.052*	-0.006	1.157
	Neutral	0.254	0.341	0.461	-0.435	0.943
Neutral	Trump	0.321	0.361	0.379	-0.409	1.051
	Hillary	-0.254	0.341	0.461	-0.943	0.435

Based on estimated marginal means
a. Adjustment for multiple comparisons: LSD (equivalent to no adjustments).

Note: Each condition (i.e., Trump, Hillary, Neutral) refers to the Respiratory Sinus Arrhythmia measured during the video stimulus presentation.

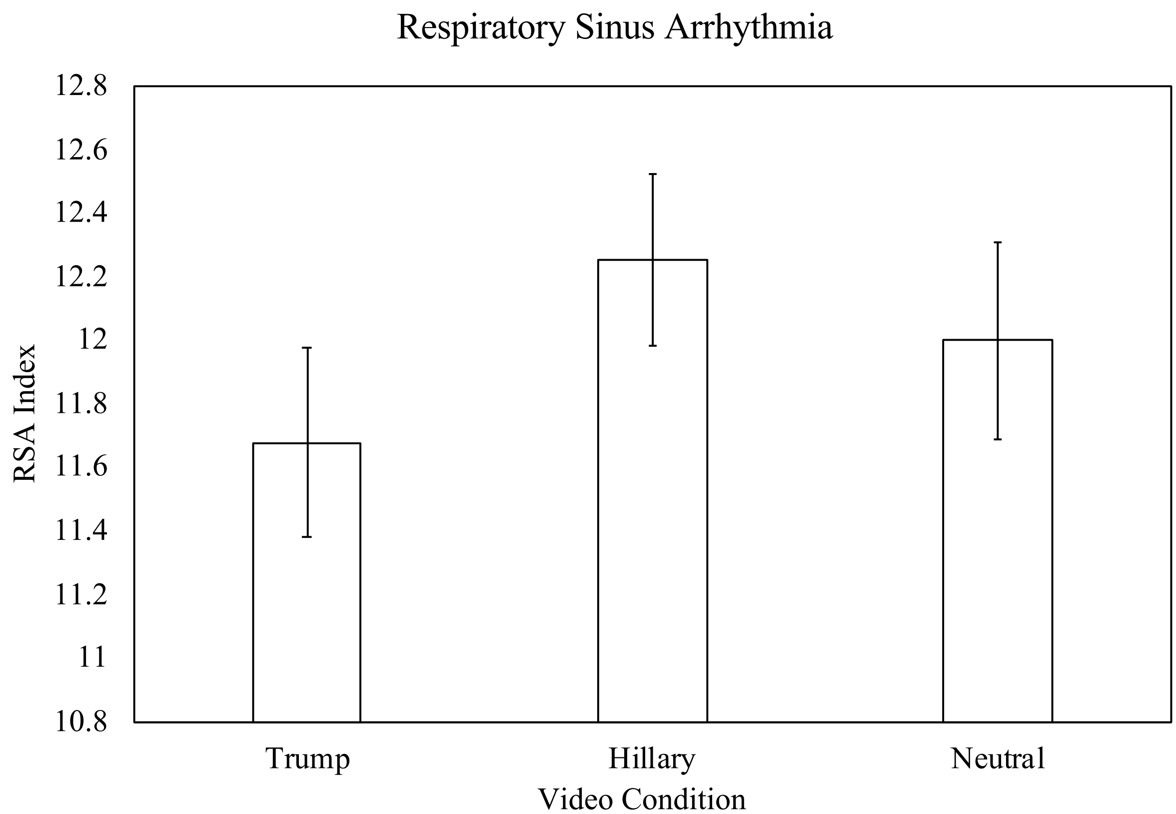

Figure 4. Respiratory Sinus Arrhythmia. This figure illustrates the mean Respiratory Sinus Arrhythmia measured during each condition with standard error for the error bars.

Discussion

The scientific literature reveals mixed results on the nature of emotion's effect on executive functioning, and the impact of negative campaign advertisements has only begun to be explored. The current study is a first attempt to assess the emotional appeal of campaign advertisement videos from both a behavioral and physiological level and is comprised of three individual phases toward those ends. Results from Phase 3 indicate that, overall, hypotheses were unsupported despite significant results from pairwise comparisons of both behavioral (N-Back reaction time) and physiological (RSA) data. The finding that reaction time was faster in the post-Trump condition in combination with the decreased respiratory sinus arrhythmia is worthy of further discussion.

Respiratory sinus arrhythmia is a well-established, non-invasive indirect estimator of vagal tone (Berntson, Cacioppo, & Quigley, 1993) - a marker of parasympathetic control over cardiac arousal which has been extensively studied in experiments of emotion reactivity (Fortunato, Gatzke-Kopp, & Ram, 2013; Oveis et al., 2009; Thayer, Åhs, Fredrikson, Sollers III, & Wager, 2012). Low respiratory sinus arrhythmia compared to baseline is a sign of vagal withdrawal, indicative of withdrawal of the parasympathetic nervous system (Porges, 2001). Given that reaction times in the post-Trump N-Back condition were faster than both the post-Hillary and post-Neutral conditions, it is possible that the increased sympathetic arousal in the Trump-video condition, as indexed by the decreased RSA, resulted in a slight boost in reaction time following stimulus presentation. This finding appears contradictory to research on the detrimental effects of emotional distractors on working memory (Dolcos & McCarthy, 2006), the deleterious effect of impaired feature binding processes of working memory via emotional arousal (Mather et al., 2006) and the reduction of working memory-related activity due to acute psychological stress (D. M. Diamond, Fleshner, Ingersoll, & Rose, 1996; Qin, Hermans, van Marle, Luo, & Fernández, 2009). However, other research has suggested that acute stress enhances excitatory activity in the prefrontal cortex and facilitates working memory (Yuen et al., 2009) lending support to the “inverted U” relationship suggested to exist in relation to arousal and performance (Yerkes & Dodson, 1908). It is quite possible that the Trump video induced a level of arousal that facilitated performance on the working memory task, but further research is necessary to establish such a claim.

Exploratory data analyses also revealed sex differences with respect to the *N*-Back reaction time. A repeated measures ANOVA using *N*-Back reaction time as the within-subjects factor and *sex* as the between subjects factor yielded a significant interaction of sex and condition, $F(2,80) = 3.457$, $p = .036$, $\eta_p^2 = .08$ (Figure 5).

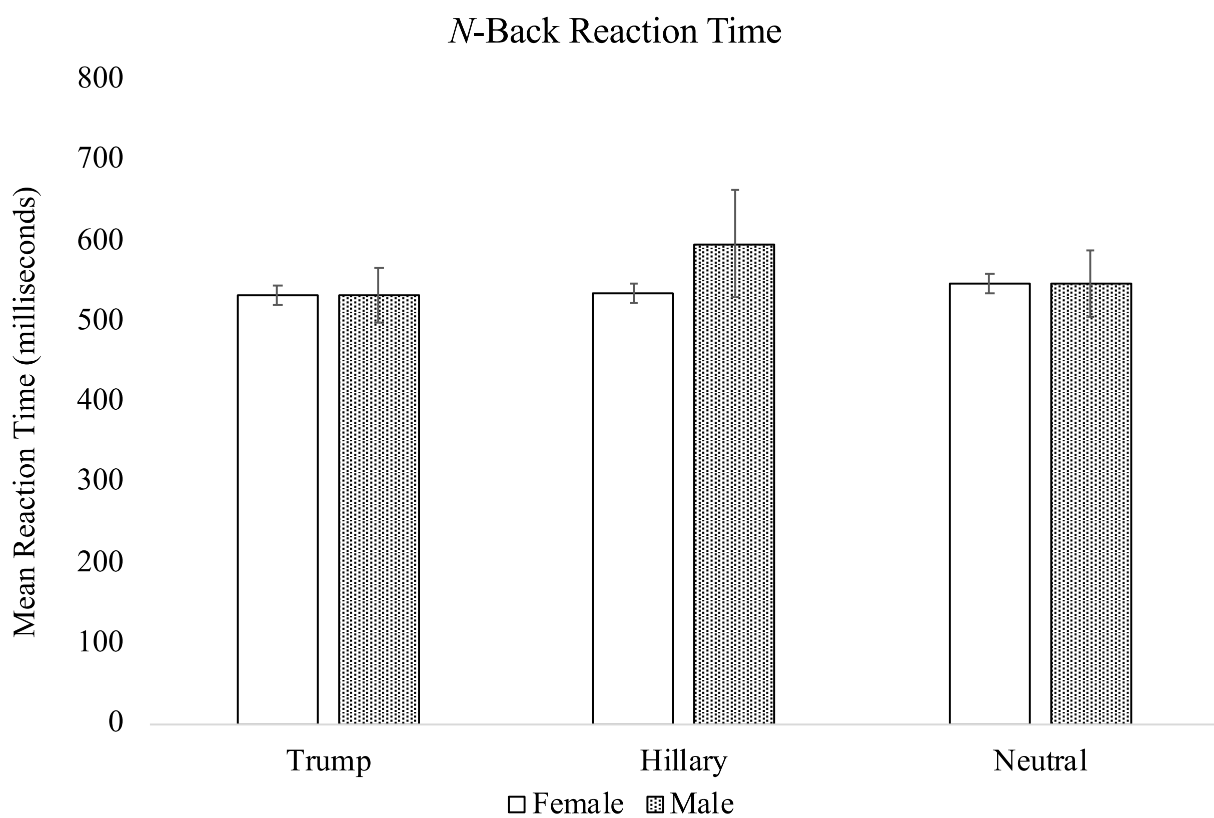

Figure 5. Mean *N*-Back Reaction Time for females and males across all conditions.

The males appear to have reacted significantly slower in the Hillary condition, driving the interaction. One major caveat with this finding is the disparate number of males in the study ($n = 6$). Indeed, upon analyzing only the males, repeated measures ANOVA with *N*-Back reaction time as the within-subjects factor revealed no significant differences between conditions, $F(2,10) = 1.153$, $p = .354$, $\eta^2 = .187$. A larger sample size is necessary before making any claims relevant to sex differences which may be present.

One other possibility for the lack of physiological effects may be that the stimuli were not arousing. To address this possibility, we did post-hoc exploratory analyses on our subjective experience questionnaires which were given at the break after each video. Though the physiological data did not indicate significant variability in arousal between conditions, a repeated measures ANOVA on the "arousal" items on the post-video Pleasure Arousal Dominance questionnaire (with mean arousal as the within-subjects factor) revealed significant differences between video conditions $F(2,76) = 42.124$, $p = <.001$, $\eta^2 = .526$, essentially mirroring the results of the Phase 1 pilot study (Figure 6).

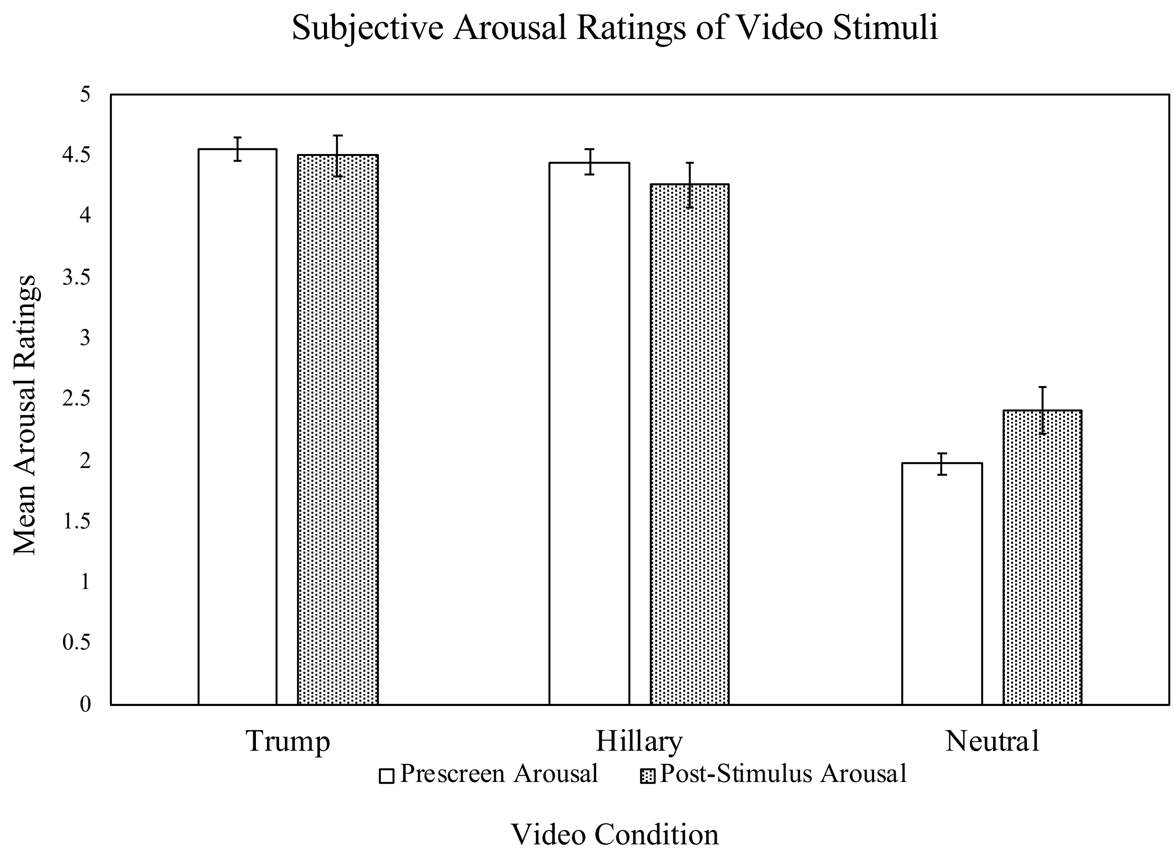

Figure 6. Post-Stimulus Arousal. This figure illustrates the mean arousal scores given by participants after viewing each of the video conditions.

Given that the physiological data do not show this significant variation, it is possible that the participants' arousal ratings were biased the due to demand characteristics produced by the stimulus set. That is, rather than experiencing physiological arousal as a by-product of the stimulus, perhaps participants anticipated a desired experimental outcome and conformed their self-report data to fall in line with that outcome.

Limitations and Future Directions

There are several limitations which may explain the results. First, the behavioral tasks were intentionally designed to be relatively easy due to the length of the experiment – averaging around 45 minutes per participant – which I anticipated may impact the participants' ability to perform the task. Upon assessment of the accuracy scores, the 1-back test appears to show a ceiling effect which prevented any meaningful variation in the results. Further, the Go/No-Go task results revealed a similar ceiling effect pattern in the data and, therefore, no meaningful variations in the data exist. Given the ceiling effect, it is quite likely that the only meaningful data from the behavioral data lies within the reaction time data. The analysis of reaction time within tasks of executive function in light of ceiling effects is consistent with previous literature (Hur, Iordan, Dolcos, & Berenbaum, 2017; Nelson, Crisostomo, Khericha, Russo, & Thorne, 2012). In addition to the ceiling effects of the behavioral tasks, sample size is another potential limitation. Because the pairwise comparisons of the N-Back test and RSA revealed significant differences between conditions, it's possible that a larger sample size would be more sensitive to detecting an effect in the behavioral data and bring rise to meaningful variation in the physiological data. Finally, it is possible that the Trump and Hillary conditions were not significantly different than the Neutral condition due to unanticipated physiological arousal elicited by the Neutral condition, despite the low subjective arousal ratings during Phase 1 and in the questionnaire given during the experiment after presentation of each video.

Future investigations of the effects of emotionally arousing character ads should focus on large, diverse samples in order to generate more meaningful data. In addition to larger sample sizes, perhaps it is advisable to increase the level of difficulty of the behavioral tasks to an optimal level to increase variability in the data and avoid ceiling effects. Finally, future investigations of this type should consider using a “true” neutral condition so as to be sure that there are no unanticipated physiological arousal effects.

In conclusion, the present study has introduced a novel procedure for assessing the potential impact of character-based campaign advertisement videos on the general population which have important practical implications for psychologists, mainstream media, politicians, and the electorate to which they intend to influence.

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Appendix A

Information Letter

The Auburn University Institutional Review Board has approved this Document for use from 02/07/2018 to 02/07/2019
Protocol # 17-036 MR 1703

PSYCHOLOGY

AUBURN UNIVERSITY

COLLEGE OF LIBERAL ARTS

Informed Consent Form for a Research Study

"Emotional Disruption of Executive Function"

Department of Psychology

You have received the invitation code for this study because you are invited to participate in the second phase of a research study that involves rating films for emotional content while wearing electrodes. The study is being conducted by Ryan Bird, a doctoral student under the supervision of Dr. Jennifer Robinson at the Department of Psychology of Auburn University. You were selected as a potential participant because you are 19 years of age or older, have completed Phase 1 of the study previously, and have met requirements for inclusion in Phase 2. If you have not completed Phase 1 previously, which involved taking psychological screening scales, please discontinue the study.

What will be involved if you participate? Should you decide to participate, you will come to the lab in Thach 108C, be fitted with electrodes to measure your physiological responses, and be asked to rest while we take some baseline physiological measurements. You will then take a series of tests of executive function and watch a series of film clips, after which you will rate your emotional reaction and your arousal will be measured (excitement). Following the film viewing portion of the study you will be asked to complete the same executive function tasks. Your participation may last approximately 45 minutes to 1 hour.

Physiological measurements. We will be measuring some of your body's physiological responses. Specifically, we will be recording skin conductance, respiration, facial muscle contraction, and heart rate measurements. These measures will allow us to better understand how your body reacts to viewing films. To collect this data, we will need to put electrodes on your body. The experimenter can put on these electrodes, or you can put them on by yourself. A diagram will be provided to you if you would like to put them on by yourself. There will be two electrodes placed on the middle and ring finger of your nondominant hand and to prepare for application you may clean your hands with a baby wipe. One electrode will be placed on your right collarbone and one on your left side, above your waistband, before which the exfoliant will also be used. Finally, you will also wear a belt across your abdomen/chest to measure respiration. If you feel uncomfortable at any time, you may discontinue the experiment. Before the electrodes are applied, the researcher will describe each electrode and its purpose. After electrode application, you will be allowed to become used to wearing them for 5 minutes before you watch the films.

226 Thach Hall, Auburn, AL 36849-5214; Telephone: 334-844-4412; Fax: 334-844-4447

w w w . a u b u r n . e d u

Are there any risks or discomforts? The risks associated with participating in this study are:

1. One of the potential risks to be considered in this study includes the risk of revealing personal and sensitive information on the part of the participant. Participants will be asked personal questions regarding their health status.

2. Another potential risk is discomfort to the participant associated with being asked to reveal personal information.

3. There is risk of emotional distress due to the political content of some of the films.

4. Some people may feel uncomfortable putting electrodes on, or taking electrodes off of their skin. You may choose not to participate.

5. Some people may be allergic to electrode gel and should not participate in the study.

To minimize these risks, we will:

1. In order to protect the confidentiality of all information, consent forms attained will be immediately collected and placed in a locked cabinet. While the probability of a breach of confidentiality is low, the magnitude of social harm if a breach of confidentiality occurs is high especially with respect to the sensitive items (i.e., medical history). All forms will be coded with your study-specific unique participant identification number, and stored in a private office, in a locked filing cabinet. Electronic data will be on password-protected computers and servers with limited access to only the investigators on this study. All data will be stripped of identifiable information and provided with a study specific unique participant identification number.
2. In order to minimize the risk of discomfort by revealing personal information, you will be given the option to refuse to answer most questions without penalty or exclusion from the study, with the exception of those presented in the screening process, which are necessary to ensure your safety and eligibility.
3. To minimize the risk, you will be given the option to skip any item/film clip or to discontinue the study at any time. All videos are taken from YouTube. The particular scenes you will view are publicly available without restriction on the Internet. You will also be given a referral form listing local psychological services available in the case that you experience more intense psychological distress.
4. We will allow you the option to place the electrodes on your own body to minimize modesty concerns.
5. In order to minimize electrode discomfort and skin irritation, a non-irritating, hypo- allergenic gel used as a conductant.

Will you receive compensation for participating? To thank you for your time, SONA credit as well as a bonus for returning to complete Phase 2. *Your participation is completely voluntary.* If you change your mind about participating, your data will be withdrawn. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University and the Department of Psychology.

If you have questions about this study, please contact Ryan Bird (rtb0018@auburn.edu), or Dr. Jennifer Robinson (jrobinson@auburn.edu).

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

Participant's Initials ___________

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

_________________________________ _________________________________
Participant's signature Date Investigator obtaining consent Date

_________________________________ _________________________________
Print Name Print Name

The Auburn University Institutional Review Board has approved this Document for use from
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Protocol # 17-036 MR 1703

Appendix B

Pleasure Arousal Dominance Scale
Emotional valence questionnaire to be given after each block of the study. This will identify the specific emotion/arousal reported by the participants (below).

Please circle the number **1** through **7** which best describes how the film segment made you feel. For example if the film segment made you feel **VERY CALM** you would circle **1**, however if the film made you feel **VERY EXCITED** you would circle **7**. If the film segment made you feel **NEITHER CALM NOR EXCITED** you would circle **4**. There are no right or wrong answers. Please make sure you complete all the items.

Calm	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Excited**
Unsatisfied	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Satisfied**
Submissive	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Dominant**
Dull	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Jittery**
Relaxed	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Stimulated**
Controlled	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Controlling**
Annoyed	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Pleased**
Despairing	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Hopeful**
Influenced	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Influential**
Sluggish	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Frenzied**
Unhappy	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Happy**
Cared for	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**In Control**
Unaroused	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Aroused**
Bored	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Relaxed**
Guided	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Autonomous**
Sleepy	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Wide awake**
Melancholic	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Contented**
Awed	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Important**

Appendix C

Part 1: Emotional Disruption of Executive Function Demographics Questionnaire

What is your e-mail address you used to sign up for this study? NOTE: This will ONLY be used to invite you to the second phase of the study and will then be DELETED from your data so that the researchers will NO LONGER have access to ANY of your identifying information attached to your responses.

- Age
- Sex: Female (1) Male (2)
- Ethnicity

Part 2: Medical Questionnaire

Have you ever experienced or been diagnosed with any of the following, or are you experiencing any of the following at present?

- Severe trauma/head injury
- Stroke
- Epilepsy or seizures
- Neurological surgery
- Other neurological problems
- Cardiovascular disease
- Psychiatric illness
- Are you currently taking any prescription medications?
- Please explain "yes" responses.
- Would you be willing to refrain from caffeine for three (3) hours before participating in future research?

Part 3: Handedness Questionnaire

Please check the box with the corresponding answer. Also, please check the box with the prompt "Do you ever use the other hand" and insert either "yes" or "no".

- Writing
- Drawing
- Throwing
- Using scissors
- Using a toothbrush
- Using a knife (without a fork)
- Using a spoon
- Using a broom
- Striking a match
- Opening a box (holding the lid)
- Holding a computer mouse
- Using a key to unlock a door
- Holding a hammer
- Holding a brush or comb
- Holding a cup while drinking

Part 4: Big Five Inventory

Instructions: Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please click a number next to each statement to indicate the extent to which you agree or disagree with that statement.

- 1 - Disagree strongly
- 2 - Disagree a little
- 3 - Neither agree or disagree
- 4 - Agree a little
- 5 - Agree strongly

I am someone who...

1. Is talkative
2. Tends to find fault with others
3. Does a thorough job
4. Is depressed, blue
5. Is original, comes up with new ideas
6. Is reserved
7. Is helpful and unselfish with others
8. Can be somewhat careless
9. Is relaxed, handles stress well
10. Is curious about many different things
11. Is full of energy
12. Starts quarrels with other
13. Is a reliable worker
14. Can be tense
15. Is ingenious, a deep thinker
16. Generates a lot of enthusiasm
17. Has a forgiving nature
18. Tends to be disorganized
19. Worries a lot
20. Has an active imagination
21. Tends to be quiet
22. Is generally trusting
23. Tends to be lazy
24. Is emotionally stable
25. Is inventive
26. Has an assertive personality
27. Can be cold and aloof
28. Perseveres until the task is finished
29. Can be mood
30. Values artistic, aesthetic experiences
31. Is sometimes shy, inhibited
32. Is considerate and kind to almost everyone
33. Does things efficiently
34. Remains calm in tense situations
35. Prefers work that is routine
36. Is outgoing, sociable
37. Is sometimes rude to others
38. Makes plans and follows through with them
39. Gets nervous easily
40. Likes to reflect, play with ideas
41. Has few artistic interests
42. Likes to cooperate with others
43. Is easily distracted
44. Is sophisticated in art, music, or literature

Part 5: PTSD Checklist

Below is a list of problems that people sometimes have in response to a very stressful experience. Please read each problem carefully and then select the answer to indicate how much you have been bothered by that problem in the past month.

- Not at all (1)
- A little bit (2)
- Moderately (3)
- Quite a bit (4)
- Extremely (5)

1. Repeated, disturbing, and unwanted memories of the stressful experience?
2. Repeated, disturbing dreams of the stressful experience?
3. Suddenly acting or feeling as if the stressful experience were actually happening again (as if you were actually back there reliving it)?
4. Feeling very upset when something reminded you of the stressful experience?
5. Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?
6. Avoiding memories, thoughts, or feelings related to the stressful experience?
7. Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?
8. Trouble remembering important parts of the stressful experience?
9. Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?
10. Blaming yourself or someone else for the stressful experience or what happened after it?
11. Having strong negative feelings such as fear, horror, anger, guilt, or shame?
12. Loss of interest in activities that you used to enjoy?
13. Feeling distant or cut off from other people?
14. Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)?
15. Irritable behavior, angry outbursts, or acting aggressively?
16. Taking too many risks or doing things that could cause you harm?
17. Being "super alert" or watchful or on guard?
18. Feeling jumpy or easily startled?
19. Having difficulty concentrating
20. Trouble falling or staying asleep?

Part 6: Beck Depression Inventory

This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Choose the number beside the statement that you have picked. If several statements in the group seem to apply equally well, choose the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

Sadness
0 - I do not feel sad.
1 - I feel sad much of the time.
2 - I am sad all the time.
3 - I am so sad or unhappy that I can’t stand it.

Pessimism
0 - I am not discouraged about my future.
1 - I feel more discouraged about my future than I used to be.
2 - I do not expect things to work out for me.
3 - I feel my future is hopeless and will only get worse.

Past Failure
0 - I do not feel like a failure.
1 - I have always failed more than I should have.
2 - As I look back, I see a lot of failures.
3 - I feel I am a total failure as a person.

Loss of Pleasure
0 - I get as much pleasure as I ever did from the things I enjoy.
1 - I don’t enjoy things as much as I used to.
2 - I get very little pleasure from the things I used to enjoy.
3 - I can’t get any pleasure from the things I used to enjoy.

Guilty Feelings
0 - I don’t feel particularly guilty.
1 - I feel guilty over many things I have done or should have done.
2 - I feel quite guilty most of the time.
3 - I feel guilty all of the time.

Punishment Feelings
0 - I don’t feel I am being punished.
1 - I feel I may be punished.
2 - I expect to be punished.
3 - I feel I am being punished.

Self-Dislike
0 - I feel the same about myself as ever.
1 - I have lost confidence in myself.
2 - I am disappointed in myself.
3 - I dislike myself.

Self-Criticalness
0 - I don’t criticize or blame myself more than usual.
1- I am more critical of myself than I used to be.
2 - I criticize myself for all of my faults.
3 - I blame myself for everything bad that happens.

Crying
0 - I don’t cry any more than I used to.
1 - I cry more than I used to.
2 - I cry over every little thing.
3 - I feel like crying, but I can’t.

Agitation
0 - I am no more restless or wound up than usual.
1 - I feel more restless or wound up than usual.
2 - I am so restless or agitated that it’s hard to stay still.
3 - I am so restless or agitated that I have to keep moving or doing something.

Loss of Interest
0 - I have lost interest in other people or activities.
1 - I am less interested in other people or things than before.
2 - I have lost most of my interest in other people or things.
3 - It’s hard to get interested in anything.

Indecisiveness
0 - I make decisions about as well as ever.
1- I find it more difficult to make decisions than usual.
2 - I have much greater difficulty in making decisions than I used to.
3 - I have trouble making any decisions.

Worthlessness
0 - I do not feel I am worthless.
1 - I don’t consider myself as worthwhile and useful as I used to.
2 - I feel more worthless as compared to other people.
3 - I feel utterly worthless.

Loss of Energy
0 - I have as much energy as ever.
1 - I have less energy than I used to have.
2 - I don’t have enough energy to do very much.
3 - I don’t have enough energy to do anything.

Changes in Sleeping Pattern
0 - I have not experienced any change in my sleeping pattern.
1a - I sleep somewhat more than usual.
1b - I sleep somewhat less than usual
2a - I sleep a lot more than usual.
2b - I sleep a lot less than usual.
3a - I sleep most of the day.
3b - I wake up 1-2 hours early and can’t get back to sleep.

Irritability
0 - I am no more irritable than usual.
1 - I am more irritable than usual.
2 - I am much more irritable than usual.
3 - I am irritable all the time.

Changes in Appetite
0 - I have not experienced any change in my appetite.
1a - My appetite is somewhat less than usual.
1b - My appetite is somewhat greater than usual.
2a - My appetite is much less than before.
2b - My appetite is much greater than usual.
3a - I have no appetite at all.
3b - I crave food all the time.

Concentration Difficulty
0 - I can concentrate as well as ever.
1 - I can’t concentrate as well as usual.
2 - It’s hard to keep my mind of anything for very long.
3 - I find I can’t concentrate on anything.

Tiredness or Fatigue
0 - I am no more tired or fatigued than usual.
1 - I get more tired or fatigued more easily than usual.
2 - I am too tired or fatigued to do a lot of the things I used to do.
3 - I am too tired or fatigued to do most of the things I used to do.

Loss of Interest in Sex
0 - I have not noticed any recent change in my interest in sex.
1 - I am less interested in sex than I used to be.
2 - I am much less interested in sex now.
3 - I have lost interest in sex completely.

Part 7: Beck Anxiety Inventory

Below is a list of common symptoms of anxiety. Please carefully read each item in the list. Indicate how much you have been bothered by each symptom during the past week, including today by choosing the space in the column next to each symptom.

- Not at all
- Mildly
- Moderately
- Severely

1- Numbness or tingling.
2- Feeling hot.
3- Wobbliness in legs
4- Unable to relax
5- Fear of the worst happening.
6- Dizzy or lightheaded.
7- Heart pounding or racing.
8- Unsteady
9- Terrified.
10- Nervous.
11- Feelings of choking.
12- Hands trembling
13- Shaky.
14- Fear of losing control
15- Difficulty breathing.
16- Fear of dying.
17- Scared.
18- Indigestion or discomfort in abdomen.
19- Faint.
20- Face flushed.
21- Sweating (not due to heat).

Part 8: Political Party

Please choose the political party you identify with most:

- Democratic Party
- Republican Party
- Libertarian Party
- Green Party
- Other (please use text box to identify political affiliation)

Part 9: Right-Wing Authoritarianism Scale

Please indicate your reaction to each statement according to the following scale:

Answer -4 if you very strongly disagree with the statement.
Answer -3 if you strongly disagree with the statement.
Answer -2 if you moderately disagree with the statement.
Answer -1 if you slightly disagree with the statement.
Answer +1 if you slightly agree with the statement.
Answer +2 if you moderately agree with the statement.
Answer +3 if you strongly agree with the statement.
Answer +4 if you very strongly agree with the statement.
If you feel exactly and precisely neutral about an item, write down a “0."

1. Our country desperately needs a mighty leader who will do what has to be done to destroy the radical new ways and sinfulness that are ruining us.

2. Gays and lesbians are just as healthy and moral as anybody else.

3. It is always better to trust the judgment of the proper authorities in government and religion than to listen to the noisy rabble-rousers in our society who are trying to create doubt in people’s minds

4. Atheists and others who have rebelled against the established religions are no doubt every bit as good and virtuous as those who attend church regularly.

5. The only way our country can get through the crisis ahead is to get back to our traditional values, put some tough leaders in power, and silence the troublemakers spreading bad ideas.

6. There is absolutely nothing wrong with nudist camps.

7. Our country needs free thinkers who have the courage to defy traditional ways, even if this upsets many people.

8. Our country will be destroyed someday if we do not smash the perversions eating away at our moral fiber and traditional beliefs.

9. Everyone should have their own lifestyle, religious beliefs, and sexual preferences, even if it makes them different from everyone else.

10. The “old-fashioned ways” and the “old-fashioned values” still show the best way to live.

11. You have to admire those who challenged the law and the majority’s view by protesting for women’s abortion rights, for animal rights, or to abolish school prayer.

12. What our country really needs is a strong, determined leader who will crush evil, and take us back to our true path.

13. Some of the best people in our country are those who are challenging our government, criticizing religion, and ignoring the “normal way things are supposed to be done.”

14. God’s laws about abortion, pornography and marriage must be strictly followed before it is too late, and those who break them must be strongly punished.

15. There are many radical, immoral people in our country today, who are trying to ruin it for their own godless purposes, whom the authorities should put out of action.

16. A “woman’s place” should be wherever she wants to be. The days when women are submissive to their husbands and social conventions belong strictly in the past.

17. Our country will be great if we honor the ways of our forefathers, do what the authorities tell us to do, and get rid of the “rotten apples” who are ruining everything.

18. There is no “ONE right way” to live life; everybody has to create their own way.

19. Homosexuals and feminists should be praised for being brave enough to defy “traditional family values”

20. This country would work a lot better if certain groups of troublemakers would just shut up and accept their group’s traditional place in society