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Mindfulness Training to Enhance Emotion Regulation in a Polarizing Political Context: A Multimethod Investigation

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A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy in Psychology

ABSTRACT OF THE DISSERTATION

Mindfulness Training to Enhance Emotion Regulation in a Polarizing Political Context: A Multimethod Investigation

By Hadley Rahrig

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The U.S. continues to show an upward trend in political polarization, perceived as a moral divide between liberal and conservative ideological groups. This moralization of political identity has contributed to the escalation of negative emotions (e.g., fear, anger, and hatred) directed towards political outgroup members. Although negative emotions are potent motivators of political intolerance, these emotions are nevertheless subject to regulation. Mindfulness offers a promising yet understudied emotion regulation strategy which may facilitate open receptivity towards opposing partisans. The present randomized controlled trial (RCT) examines the effects of short-term mindfulness training (MT) vs structurally equivalent Cognitive Reappraisal training (CT) on the regulation of political intergroup negative affect using an ecologically-situated naturalistic neuorimaging paradigm. Functional near-infrared spectroscopy (fNIRS) neural synchrony effects coupled with emotion reactivity ratings reveal an ostensible pathway for the mindful regulation of negative intergroup emotion.

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Background

From a political sciences perspective, *political polarization* describes the ideological divide that separates political parties (Mason, 2015). However, mounting evidence suggests that as a psychological construct, political polarization is critically shaped by partisan social identity (Iyengar et al., 2019). While individuals may possess any number of social identities with which they use to navigate the world, in a polarized society such as America, political identity takes a prominent position, with some going as far as to call it a "mega-identity" (Finkel et al., 2020). Partisan social identity is likewise characterized by strong negative affect towards opposing partisans, a concept known as *affective polarization* (Iyengar et al., 2019), or *toxic polarization* due to its deleterious effects on democracy (Moore-Berg et al., 2020). Recently, it has been proposed that political and affective polarization may be subsumed under the construct of *political sectarianism*, defined as the conceptualization of political parties as morally opposed groups (Finkel et al., 2020). Such moralization may consequently sustain intergroup conflict by reinforcing behaviors such as intergroup aversion and dehumanization (Finkel et al., 2020; Garrett & Bankert, 2020). In sum, political polarization does not merely describe differences in ideological opinion; rather, it is a concept deeply rooted in psychological forces of emotion and identity. While differences in ideology will – in all likelihood – continue to exist, political polarization is not a necessary consequence of ideological diversity. Interventions attuned to such psychological forces may yet be able to mitigate the emotional and cognitive influences of political polarization at an individual, and potentially, a societal level. To this aim, the proposed research seeks to understand if and how facets of political polarization are amenable to psychological intervention.

Cognitive Consequences of Political Polarization

While the causes of political polarization are debated among scholars (Layman et al., 2006; Barber & McCarty, 2015), the personal and societal consequences of such polarization are well-known and profound. Among such consequences is the vulnerability to cognitive bias. It is perhaps unsurprising that individuals refer to their political group when forming attitudes about particular policies, given that individuals are motivated to align their values in a manner that is congruent with those of their ingroup (Cohen, 2003). However, these cognitive biases may also impact how factual information is received, especially when such information includes group-relevant information. This premise is supported by survey data indicating that Democratic and Republican partisans in the U.S. disagree about the validity of documented facts, with bias predominating in the spheres of science and economics (e.g., climate change, vaccination, unemployment rate, national debt, stock market performance). According to experimental and neuroimaging research, the effects of partisanship on cognition may even extend to processes of visual perception (Caruso et al., 2009; Molenberghs et al., 2013). For example, participants who viewed a political protest recording were more likely to describe demonstrator behavior as disruptive or aggressive when given the information that protesters supported an opposing partisan cause (e.g., a liberal viewer believes they are viewing an anti-abortion demonstration), compared to particpants who believed that protesters supported a co-partisan issue (e.g., a liberal viewer viewing the protest of "don't ask, don't tell") (Kahan et al., 2012a). Thus, investment in political identity can effectively increase susceptibility to misinformation (Sanchez & Dunning, 202) and reinforce the "reality gap" (Dunning, 2016) that separates Democrats from Republicans. Unfortunately, partisan cognitive biases may be resilient to interventions promoting deliberate cognitive rationales (Kahan et al., 2012b; Drummond & Fischhoff, 2017) (but see Fernbach et al., 2013), as automatic moral evaluations may instead determine the trajectory of

cognitive reasoning (Taber & Lodge, 2016), particularly when social identity motives are high (Van Bavel & Pereira, 2018).

Effect of Political Polarization on Partisan Prejudice

The impact of political polarization on intergroup prejudice is unambiguous, with partisan prejudice surpassing prejudice of both racial and religious outgroups (Iyengar & Westwood, 2015; Westwood et al., 2018). While social norms typically censure discriminatory behavior, rhetoric from political leaders may instead cue social information that prejudice towards opposing partisans is sanctioned (Iyengar et al., 2012). Moreover, cable news outlets and social media platforms have demonstrably amplified messages of out-party derogation (Wilson et al., 2020; Brady et al., 2021). Indeed, according to a Pew research poll[ii] the top three attributes Republicans used to describe Democrats were *close-minded*, *immoral*, and *lazy*. Likewise, the top three attributes Democrats assigned to Republicans were *close-minded*, *dishonest*, and *immoral* (Duggan & Smith, 2016). It is possible that such appraisals are indicative of a broader pattern of perceived moral distance between parties. This position receives indirect support from recent survey data revealing a positive correlation between political identification and blatant dehumanization of opposing partisans (Cassese, 2021). Importantly, Cassese (2021) demonstrated that such blatant dehumanization likewise predicts perceived moral superiority and preference for social distance. Thus, perceived moral differences between political partisans may motivate political social homophily, or the desire to associate with those who are politically like-minded (Huber & Malhotra, 2017). In this vein, experimental research revealed that Democratic job applicants were 39% less likely to receive a callback when applying to jobs within a conservative county, and Republican applicants were 31% less likely to receive a callback within a liberal county (Gift & Gift, 2015). Such homogeneity may also be expressed in close

relationships, as research suggests that political agreement ranks among the most relevant criteria for partner selection (Iyengar et al., 2018).

Implications of Political Polarization for Democracy

Social identities motivate behaviors to protect and advance group status (Tafjel, 2918). Political identity is no exception to this principle as it is closely tied to political engagement. Individuals with strong attachments to political identity are more likely to mobilize campaign support in response to out-party threats and re-assurances (Huddy et al., 2015). In this respect, partisans are motivated by feelings of anger (following threatening messages) and enthusiasm (following reassuring messages) to support the interests of the in-group (Huddy & Mason, 2008). While political engagement (e.g., voting, campaign support) is a sign of a healthy democracy, such partisanship may not always be in the ideological interests of the electorate, who are more likely to support policies on the basis of in-group endorsement than of personal ideology (Cohen et al., 2003). Moreover, political candidates are incentivized to deliver campaign messages that provoke anger, given that emotion has a uniquely potent influence on political mobilization (Valentino et al., 2011). Such emotional rhetoric, amplified through social media and news outlets, further reinforces perceptions of intergroup hostility and division (Wilson et al., 2020).

Messages from media "echo chambers" and political elites can also incite *lethal* forms of political engagement (Kalmoe & Mason, 2019), as illustrated by the January 6th Capitol insurrection (Gardner & Helderman, 2021). Although concerning, such violence is arguably predictable given that large portions (10-60%) of American partisans report feelings of *moral disengagement*, the viewpoint that harm against opposing partisans is morally justifiable (Kalmoe & Mason, 2019). In the same study, a small but troubling portion (5-15%) of respondents endorsed *partisan violence* in the form of threats or physical harm, with support for

violence increasing in light of an anticipated electoral victory (Kalmoe & Mason, 2019). Thus, animus between Republican and Democratic partisans continues to escalate during a historical moment in which bipartisan action is increasingly critical for coping with challenges such as the COVID-19 pandemic and climate change (among other social, ecological, and financial crises). Political polarization however, undermines political power by decreasing trust in and compliance with public authorities (Milosh et al., 2021), while increasing preference for antidemocratic policies (Kingzette et al., 2021) and avoidance of intergroup cooperation (Dimant, 2021; Whitt et al., 2021).

False and Misperceived Polarization

Thus far I have summarized the prevalence and consequences of political polarization. However, considerable research suggests that beliefs about polarization may be largely *fictional*, meaning that the magnitude of partisan disagreement is chronically overestimated (Chambers et al., 2006; Westfall et al., 2015; Levendusky & Malhotra, 2016). National survey data reveals that Americans believe Democrats and Republicans differ drastically in their core values (Westfall et al., 2015; Levendusky & Malhotra, 2016). In reality, Democratic and Republican partisans largely share the same values and merely differ in their levels of prioritization (Blatz & Mercier, 2018). Notably, misperception of ideological disparities is greatest for beliefs that are central to one's identity (Chambers et al., 2006). For example, a Democratic voter who considers protection of the poor as a core value assumes that Republicans would prefer to disregard the poor entirely for the sake of the wealthy. In contrast, data suggests that Republicans and Democrats both hold relatively moderate opinions regarding the role of government assistance for poor families (Westfall et al., 2015). It has been suggested that such *false* or *misperceived polarization* is driven by *cognitive egocentrism*, loosely defined as the predisposition to use self-

relevant information as a basis for understanding others (for review see Bocian et al., 2020). This premise dovetails with social psychological theories of *naive realism*, which stipulate that people believe their opinions are rooted in rationality and that other people will arrive at similar viewpoints if given access to the same information (Reeder et al., 2005). By this logic, one may erroneously conclude that those who hold alternative beliefs are either misinformed, irrational, or morally corrupt (Reeder et al., 2005). Such cognitive errors may contribute to the mis-perception that Republicans and Democrats stand on moral grounds separated by a wide chasm.

Erroneous beliefs about polarization can also be reinforced by biased *meta-perceptions*, or meta-cogntive beliefs about how opposing partisans view one's own party (Moore-Berg et al., 2020; Lees & Cikara, 2021). For example, research shows that Democrats and Republicans believe opposing partisans regard co-partisans with prejudice at levels twice as high as actually reported (Moore-Berg et al., 2020). The misperception of hostility consequently justifies prejudice against opposing partisans and motivates desire for social distance (Moore-Berg et al., 2020). Presently the causes of inaccurate meta-perceptions are still largely theoretical; however, it has been suggested that partisans may be especially sensitive to reputational threats when inter-group competition is salient (i.e., federal election years) (Lees & Cikara, 2021). Thus biased cognitions and meta-cognitions about opposing partisans are among the multiple contributors to polarization. However, this research potentially reveals a kernel of optimism; if ideological differences and hostilities are largely illusory, polarization may potentially be remedied by re-aligning social perceptions--and concomitant emotions--to appropriately meet the conditions of reality.

Systems Meta-Theory of Emotion

Understanding emotions may be key to untangling the complex phenomenon of political polarization, given the uniquely potent influence of emotions on political thought and action (Pilskin & Halperin, 2021). Although barriers to resolving intergroup conflict are also cognitive and motivational in nature (Friend & Malhotra, 2019), such processes are profoundly shaped by emotional experiences (Dukes et al., 2021). Given the mechanistic centrality of emotion in socio-political contexts, the current project applies a *systems meta-theory* approach (Leach & Bou Zeineddine, 2021). Basic assumptions of systems meta-theory include the following: 1) psychological phenomena are *multi-leveled*, or organized in systems at multiple levels; 2) systems at multiple levels impact each other in ways that are *complex* (as opposed to unidirectional cause-effect mechanisms); and 3) phenomena are *dynamic*, meaning that effects change across time and contexts (Leach & Bou Zeineddine, 2021). Akin to constructionist theories of emotion (Feldman Barrett, 2006), systems meta-theory stipulates that emotions emerge according to a combination of personally- and contextually-relevant factors in order to best meet situational demands. Moreover, this theory does not distinguish emotion and emotion regulation as distinct phenomena, given that individuals dynamically adjust their emotions based on real-time feedback (Hollenstein, 2015). Thus, observation of such emotions requires multi-method designs that are sensitive to the dynamic aspects of emotion across multiple levels (e.g., context and time). In order to demonstrate the experimental applications of these principles, the following section reviews four studies through the lens of systems meta-theory (Alkoby et al., 2017; Ford et al., 2019; Leong et al., 2020; Dieffenbach et al., 2021). In doing so, this exercise aims to 1) specify variables from the superordinate category of political polarization; and 2) identify plausible targets for intervention.

Naturalistic Viewing Paradigms

Multi-method designs may be leveraged to capture the interactions between micro-level (e.g., person-level) and macro-level (e.g., group-level) systems. This premise is exemplified through *naturalistic viewing paradigms*, or paradigms in which stimuli are dynamic, multimodal (i.e., multi-sensory), and embedded in socio-ecological contexts (Sonuskare et al., 2019). Common examples of such stimuli include audio-visual films (e.g., Nguyen et al., 2017), multi-person games (e.g., King-Casas et al., 2008), and live social interactions (e.g., Liu et al., 2016). Using rich, ecologically valid stimuli, naturalistic viewing paradigms aim to model scenarios that better approximate everyday life experiences, which stand in stark contrast to the abstract, unimodal stimuli (e.g., static photos) traditionally used in laboratory experiments. Pairing naturalistic viewing paradigms with neuroimaging methods has been a particularly fruitful avenue of research, given that neuroimaging methods may be used to draw inferences about systems underlying "higher level" cognitions (i.e., ideological beliefs) in interaction with early-stage processes of attention and perception. Thus, emerging research combining these methods has substantially advanced scientific understanding of how our experiences are subtly biased by factors such as beliefs (Yeshurun et al., 2017), social identity (Leong et al,. 2020; Dieffenbach et al., 2021), and ideology (Burns et al., 2019).

In order to model the way political information is naturally processed, Leong et al. (2020) used a data-driven experiment in which blood-oxygen-level-dependent (BOLD) signals were measured during passive viewing of naturalistic audio-video political content. Doing so, this study aimed to determine how political beliefs may bias early sensory processing. Neuroimaging methods can be used to draw inferences about whether systems underlining "higher level" belief systems influence functions of early stage processes of attention and perception. Using functional magnetic resonance imaging (fMRI), Leong et al. (2020) scanned liberal- or

conservative-identifying U.S. citizens as they passively watched videos on controversial political topics (i.e., immigration policies). Participants rated their support for conservative and liberal immigration policies prior to and immediately following scanning. Using an intersubject correlation (ISC) approach, Leong et al. (2020) demonstrated that activation time courses within the dorsomedial prefrontal cortex (dmPFC)--a region implicated in narrative interpretation– significantly differed between liberal and conservative participants watching the same political videos. Moreover those with dMPFC profiles most similar to the average partisan (within one's own group) were more likely to shift their policy preferences to a more polarized position. Such "neural polarization" (Leong et al., 2018; p 1) was greatest in videos with moral-emotional language, suggesting that by cueing partisan identities, moral-emotional language triggers biased interpretations of information, and that such processes may be mediated by the dmPFC.

Neural polarization effects may potentially be detected using neuroimaging modalities apart from fMRI, namely near-infrared spectroscopy (fNIRS) (Dieffenbach et al., 2021). In a recent study, Dieffenbach et al. (2021) used an ISC-based classification method, referred to as a "neural reference groups" approach (p. 1), to predict partisan ideology from fNIRS-based neural time courses. FNIRS data was collected from liberal and conservative-leaning participants while they passively viewed videos with polarizing socio-political content (i.e., viewpoints on abortion). Similar to the findings of Leong et al. (2020), results suggested that dmPFC neural time courses diverged in participants with opposing partisan stances (Dieffenbach et al., 2021). Collectively findings from Dieffenbach et al. (2021) and Leong et al. (2020) provide cross-modal (i.e., fMRI and fNIRS) evidence to suggest that the dmPFC may influence interpretation of politically salient stimuli. Moreover, these studies illustrate the potential of well-controlled, ecologically-valid experimental approaches.

Intergroup Emotion Regulation

As previously stated, a critical assumption of systems meta-theory (in respect to emotion phenomena) is that emotions are *dynamic*. In this vein, *emotion regulation*–or processes used to modify emotions (Gross, 2004)– may be considered a dynamic property of emotion, rather than a distinct phenomenon unto itself. While it is clear that partisan information provokes strong emotional reactions, research is beginning to uncover the role of emotion regulation in political contexts (Čehajić-Clancy et al., 2016).

In a recent review, Ford and Feinberg (2020) discuss the complex relationship between negative emotion and political action using motivational accounts of emotion regulation. First, Ford and Feinberg (2020) stress that individuals seek specific emotional states because they are productive for meeting personal needs or group needs. Research shows that political events consistently evoke negative emotions in American partisans (Ford et al., 2020), and that such individuals may implement a number of emotion regulation strategies to improve personal wellbeing. According to recent research (Ford et al., 2019), *cognitive reappraisal* may be particularly effective for regulating negative politically-related emotions. Cognitive reappraisal involves the deliberate modulation of thoughts (John & Gross, 2004), and in a political context, may manifest as rationalization of the status quo (Laurin & Jettinghoff, 2022), minimization of perceived impact, or reframing of events as meaning-making opportunities (Uusberg et al., 2019). According to longitudinal and cross-sectional evidence, reappraisal may in fact be common practice for partisans managing chronic political stress (Ford et al., 2020).

Although people are often motivated to downregulate negative emotions to improve personal wellbeing, reducing negative emotions may come at the cost of de-motivating political action (Ford & Feinberg, 2020). This premise is aptly demonstrated in a multi-method study of

cognitive reappraisal in Clinton voters following the 2016 U.S. election (Ford et al., 2019). First, Ford et al. (2019) provide correlational and longitudinal support suggesting that reappraisal may indirectly reduce political engagement. Further, participants who spontaneously used cognitive reappraisal when viewing U.S. presidential candidate Donald Trump-focused news footage appeared to manage their emotions more effectively; however, these participants also reported less intention to engage in political action. This effect was replicated in participants randomly assigned to use cognitive reappraisal during the viewing. From these results, Ford et al. (2019) concluded that while reappraisal is effective in managing negative emotions in the short-term, it may carry the caveat of reducing political action needed for long-term change. From a systems meta-theory perspective, this finding provides a key insight: *ability and tendency* to regulate politics-related emotions varies at the individual level and *motivation* to regulate such emotions may vary according to personal (i.e., hedonic) *versus* group-level (i.e., instrumental) goals.

It also warrants noting that the *type* of emotion regulation strategy has important *dynamical* implications, because different strategies operate on different time scales. For example, reappraisal requires deliberate manipulation of thoughts, which – in terms of cognitive operations – is relatively time-consuming and difficult to deploy in the midst of a distressing event (Mehta et al., 2020). Consequently, the ability to engage in reappraisal may fail in high-arousal contexts (Ford & Troy, 2019). However, emotion regulation strategies operating on shorter time scales may be able to circumvent this barrier. Emerging research suggests that strategies based in *acceptance* and *awareness* may provide some advantages over effortful strategies such as cognitive reappraisal (Subic-Wrana et al., 2014; Torre & Lieberman, 2018; Troy et al., 2018; Goldin et al., 2019).

Thus, the utility of mental training beyond reappraisal was investigated by Alkoby et al. (2017) in a study of mindfulness for political intergroup conflict in Israel-Palestine. *Mindfulness* has been defined as a mental state or mental quality of attention to present-moment emotions, thoughts, and sensations with an orientation of non-judgemental acceptance (Brown & Ryan, 2003). Although individuals vary in their natural capacity for mindfulness (Brown & Ryan, 2003), mindfulness skills can be enhanced through standardized training programs (spanning days or weeks in length), which guide participants through formal mindfulness practices (Kabat-Zinn, 1990). As applied to emotion regulation, mindfulness is somewhat unique relative to other strategies, as research suggests that it can operate implicitly or automatically rather than relying on cognitive effort (Chambers et al., 2009; Opialla et al., 2015). Theory suggests that by regularly bringing awareness to one's thoughts and emotions, mindfulness may provide critical insight regarding how unconscious thoughts bias emotions and behaviors (Dahl et al., 2015), thereby reducing implicit prejudices (for review see Berry et al., 2020). Moreover, in the context of a threatening situation, attending to difficult emotions with non-judgement may improve affect tolerance and mitigate distress reactivity (Roemer et al., 2015).

Using this framework, Alkoby et al. (2017) tested the effects of mindfulness training and reappraisal training for the reduction of negative intergroup emotions and perceptions and whether such changes would facilitate greater support for conciliatory policies. As demonstrated by prior intergroup intervention trials, cognitive reappraisal training increased support for conciliatory policies by reducing negative intergroup emotions. Mindfulness training likewise improved support for compromise. Unlike cognitive reappraisal, however, the effect of mindfulness on support for conciliation was attributed to reductions in perceived threat (in addition to reductions in negative emotions). These findings suggest that, in addition to

regulating intergroup emotions, mindfulness training may modify biased attitudes about outgroup members, even in the context of prolonged, intractable conflict. Given these results, it is plausible that challenging such biases may promote motivation for constructive political action (i.e., conciliatory policies) over violence. However, research is still necessary to establish the potential for mindfulness as an intervention for political polarization.

Mindfulness in a Politically Polarizing Context

The psychological construct of mindfulness is deeply rooted in Buddhist contemplative traditions (Williams & Kabat-Zinn, 2013). Over three decades of research has documented the impact of mindfulness (Van Dam et al., 2018), with research predominantly focusing on the application of secular mindfulness practices for reducing stress and promoting psychological and physical wellbeing. However, contemplative theories have long acknowledged the utility of mindfulness for interpersonal purposes (Davidson & Harrington, 2002). Recently, the potential of mindfulness for interpersonal wellbeing has begun to receive corroboration from empirical research (Luberto et al., 2018; Donald et al., 2019; Berry et al., 2020), with data suggesting the efficacy of mindfulness for promoting compassionate behavior, reducing prejudice, and attenuating aggressive retaliation (Berry et al., 2021).

Theory suggests that mindfulness may foster healthier relationships by reducing interpersonal anxiety (Brown et al., 2015), and that this effect may potentially generalize to intergroup systems (Price-Blackshear et al. 2017). Accordingly, a recent meta-analysis demonstrated that mindfulness significantly attenuated intergroup bias, and that this effect was consistent across multiple operationalizations (e.g., dispositional mindfulness, mindfulness training) (Oyler et al., 2021). Moreover, experimental research suggests that mindfulness may reduce intergroup avoidance (Schaefer, 2021) and facilitate compassionate helping towards

outgroup members (Berry et al., 2021). Although research on mindfulness pertaining specifically to political intergroup relations has been scarce (Alkoby et al., 2017), it is plausible that mindfulness may target key processes implicated in political polarization and its adjacent constructs (i.e., affective polarization, political sectarianism). In the following sections, I attempt to make the argument that through cultivating attention to internal experiences, mindfulness may 1) enhance emotion regulation and 2) disrupt defensive attitudes. In turn, such mechanistic outcomes may feasibly promote more benign intergroup attitudes and behaviors.

Mindful Emotion Regulation

The ability to focus attention is considered a foundational skill of mindfulness, and is developed through the repetition of directing attention to a salient object (i.e., sensations of the breath), noting when attention wanders, and re-orienting attention back to the object of focus (Lutz et al., 2008). Mechanistically, it is suggested that repeated practice in attentional focus promotes cognitive control, mediated by heightened engagement of frontoparietal control (FPCN) regions (Hölzel et al., 2011; Tang et al., 2015). This viewpoint is supported by meta-analytic evidence indicating increased fronto-cortical gray matter volume (Fox et al., 2014) and strengthened FPCN activation (Boccia et al., 2015) associated with meditation training. Given that FPCN regions facilitate top-down control of emotion-generative brain regions (Ochsner et al., 2009), it is plausible that enhanced activity or functional cohesion in such regions may reduce cognitive effort needed to regulate emotions (Chiesa et al., 2013; Tang et al., 2015).

Alternatively, heightened engagement from control networks may rather reflect enhanced internal monitoring, given that FPCN regions are characterized by extensive connectivity with salience network areas involved in interoceptive processes (Leech et al., 2012). Such an explanation is more consistent with a ‘bottom-up’ regulatory framework, in which mindfulness

disrupts initial reactivity, circumventing the need for 'top-down' cognitive control of emotions (Chiesa et al., 2013). As previously stated, mindfulness is mechanistically unique relative to other forms of emotion regulation in that it may operate implicitly or indirectly (Chiesa et al., 2013). By definition, mindfulness involves observing emotions without judgment or appraisal, and with accrued practice, unpleasant emotions may be fully experienced without eliciting reactionary aversion (Roemer et al., 2015). In other words, mindful emotion regulation does not necessitate changing thoughts and emotions; instead, mindfulness operates by changing one's *relation* to or *identification with* such mental content (i.e., *decentering*; King & Fresco, 2019). This bottom-up account of mindfulness regulation is indirectly supported by studies reporting FPCN deactivation in meditators relative to novices when exposed to painful stimuli (Grant et al., 2011) or unpleasant images (Taylor et al., 2011), suggesting that mindfulness may incidentally reduce top-down emotion regulation by inhibiting initial emotional reactivity.

Bearing in mind systems meta-theory, it warrants noting that emotion regulation does not occur in a vacuum. Instead, emotion regulation takes place in a micro-level system (i.e., the individual) embedded in larger macro-systems (social-ecological settings). This point underscores a central critique from Condon (2019), who emphasizes the importance of accounting for contextual variables in the investigation of mindfulness. While few studies have examined mindful emotion regulation as a macro-level construct, research has made critical progress in understanding this phenomenon within meso-level, or relational, systems. For example, research suggests that mindfulness-driven attentional control improves discrimination of emotional facial expressions (Quaglia et al., 2019), mental state attribution, and empathy (Tan et al 2014). Such enhancements to social attention may reflect the efficient management of internal emotions (Brown et al., 2012), which unchecked can interfere with external attention in

high arousal situations, such as social conflict (Quaglia et al., 2019). This may explain why mindfulness has been linked to the attenuation of aggression following provocation (DeSteno et al., 2018; Rahrig et al., 2021) and adaptive responding in romantic couple conflict (Barnes et al., 2007). Although such mechanisms may support the resolution of conflict, it cannot be assumed that these effects will generalize at the group level. Such boundary conditions may be especially germane to the political domain, as prejudice against partisan others is considered by many to be morally justifiable (Finkel et al., 2020); and as consequence, motivation for intergroup emotion regulation may be limited. Hence, the following section delineates mechanisms by which mindfulness may potentially overcome barriers extending from group identity.

Mindfulness: Fostering Non-defensive Attitudes

It has previously been suggested that mindfulness may promote more benign intergroup relations by fostering *non-defensive attitudes* (Berry & Brown, 2017). Used here, non-defensive attitudes entail an open and receptive approach towards other people, situations, or ideas (see Berry & Brown, 2017 for review), and is conceptually antithetical to Alkoby's (2017) operational definition of *perceptions of threat*. According to theoretical accounts, non-defensive attitudes may be promoted via two mechanisms of mindfulness: *de-automatization* and *dis-identification* (Berry & Brown, 2017; Berry et al., 2020). Both constructs rely on critical assumptions of Social Identity Theory (Tafjel, 1982). First, humans are deeply social creatures that depend on groups for survival. These groups are often defined by shared worldviews; validation of such worldviews can strengthen trust and cohesion while threats to worldviews can enable conflict. Given these social forces, group identity – along with its belief and values – may be internalized as a symbolic representation of the self (i.e., social identity) (Leary, 2002). Finally, humans are predisposed to view other individuals through the lens of social identity,

which can engender stereotypic associations that may be automatically activated without conscious awareness (Greenwald & Banaji, 1995).

Mindfulness may potentially account for social identity biases via de-automatization (Berry & Brown, 2017), or the disruption of automatic reactions linked to interpersonal contexts. Indeed, intervention research suggests that mindfulness may bring awareness to automatic biases (Lueke & Gibson, 2015, Tincher et al., 2016), thereby disrupting or changing the course of automatic cognitions. While such research is promising, biases stemming from partisan identity may be particularly resistant to change, given that political identities fulfill important social goals (i.e., need to belong; epistemic closure) (Van Bavel & Pereira, 2018). Furthermore, the moral connotations attached to political identities may exacerbate perceptions of threat from opposing partisans (Finkel et al., 2020). Nevertheless, mindfulness training may have the capacity to attenuate ego-centric or self-protective reactions to opposing partisans.

According to theories of mindfulness, threats to self-identity are brought to awareness in mindfulness practice through reduced automaticity. Doing so, one is able to perceive the biases through which worldviews are interpreted and more readily accept a diversity of worldviews (Berry & Brown, 2017). This second mechanism of mindfulness, referred to as dis-identification, receives support from studies showing mindfulness to reduce self-concern (i.e., empathic distress) when exposed to the suffering of another (Berry et al., 2018). While the potential influence of (dis)identification on partisanship is still poorly understood, related theoretical frameworks have suggested moral processing as a target of mindfulness (Sevinc & Lazar, 2019). From this perspective, mindfulness-driven enhancements in attentional control and emotion regulation may alter processing of morally-salient information (Sevinc & Lazar, 2019). In this respect, it is possible that mindfulness training may improve the ability to distinguish genuine

moral dilemmas from threats to ideological social identity. However, this supposition remains speculative without further research.

Methodological Justification: Social Affective Neuroscience Approaches

Introduction

From a systems meta-theory perspective (Leach et al., 2021), psychological phenomena occur at the individual level, within the mind and instantiated in the brain. Further, this individual-level system is nested in relational-level systems within socio-ecological-level systems. By this logic, the meaning of any phenomena psychologists hope to measure is dependent upon the contexts that these larger systems provide. Through interdisciplinary theory and methods, political neuroscience has yielded crucial insights regarding the cognitive-emotional processes influencing political polarization (Jost et al., 2014). Traditional neuroscience approaches, however, are admittedly constrained by serious experimental shortcomings (Schmucker, 2001; Burns et al., 2019; Burns & Lieberman, 2022), among which are technology expenses, issues of reverse inference, and limitations to ecological validity. However, novel advancements in social neuroscience have begun to tackle these problems. The following sections will detail such advances. In the first section, I will describe how functional near-infrared spectroscopy is poised to address limitations of other neuroimaging modalities through its affordability, portability, and participant interface. Then, I will consider how novel naturalistic paradigms and data-driven approaches may yield inferences with greater ecological sensitivity.

Functional Near-Infrared Spectroscopy (fNIRS)

Functional magnetic resonance imaging (fMRI) has long been considered the gold standard for social neuroscience due to its high spatial resolution and ability to yield whole-brain

functional and anatomical information. However, technological limitations of fMRI pose serious limitations to social psychological research, which seeks to understand mental processes in socially valid contexts (Burns et al., 2019). First, fMRI use within research is prohibitively expensive, often costing hundreds of dollars per scan. Consequently, fMRI methods are only accessible to a small subset of researchers with adequate funding, further limiting potential for replication. The use of fMRI technology is also impractical for many individuals who are incapable of traveling to research sites equipped with fMRI modalities (which are immobile) or are unable to safely and comfortably undergo fMRI. Burns et al. (2019) have suggested that such limitations contribute to the overrepresentation of WEIRD (i.e., participants from white, educated, industrialized, rich, democratic locations) samples in neuroscience research. In contrast, fNIRS is relatively affordable and portable, thus allowing research teams to overcome geographical and financial constraints associated with fMRI modalities. Another advantage of fNIRS is that – unlike fMRI or electroencephalography (EEG) – it is highly tolerant of motion. This feature can improve comfort to participants, who are no longer required to remain completely motionless while using the equipment.

fNIRS: A Technical Explanation

Functional near-infrared spectroscopy (fNIRS) is a non-invasive neuroimaging device situated with bundles of optodes fastened to a stretchable fabric head cap. Like fMRI, fNIRS records brain activity as blood-oxygen-level-dependent (BOLD) signal but does so by detecting optical properties of hemoglobin concentration change (Burns et al., 2019). Placed on the scalp, optode sources from the fNIRS device emit light in the near-infrared spectra (wavelengths approximating 700-900 nm), which passes through skin and bone, and optode detectors measure reflected light. This metric can indirectly determine changes in concentration of Hb and HbO

over the course of a time series. Hb/HbO concentrations are recorded for each source-detector pair, or "channels", which can be mapped to approximate locations of cortical regions. Relative to fMRI, fNIRS is not as spatially resolved and is restricted to sampling activity from 1-2 cm of surface cortex. Nevertheless, fNIRS excels in detecting activity within prefrontal cortical structures, which are of particular interest to emotion regulation (Morawetz et al., 2017).

Neural Synchrony Approaches

Until very recently, neuroimaging experiments involved simplistic trial or block-like designs in which conditions were modeled through repeated presentation of abstract stimuli (e.g., static images) or through button pressing "behavior". Hemodynamic functions could then be convolved onto events in order to match discrete brain regions with particular cognitive functions (Friston et al., 1998). In addition to deviating far from natural social conditions, the described paradigm is also statistically restrictive. Designs of this nature contribute to the problem of reverse inference (Poldrack, 2006) because they must presuppose that a specific neural function is related to the modeled event. Moreover, recent research has demonstrated that perceptions are "hierarchically represented" in the brain, meaning that naturalistic stimuli – which are dynamic and complex – are represented at higher level cortical association regions and cannot be separated into individual discrete components (for review, see Adolphs et al., 2016). For such reasons, naturalistic viewing paradigms have garnered considerable attention in the last several years with corresponding advances in data-driven analytical techniques.

As a social species, humans demonstrate a remarkable capacity to share subjective mental states, a phenomenon known as *neural synchrony* (Hasson et al., 2004). Indeed, individuals shown prolonged naturalistic stimuli will exhibit synchronous neural activation at low-level sensory regions and high-level association cortices (Hasson et al., 2010), with synchrony at

higher-level cortices reflecting degree of shared comprehension or interpretation of stimuli (Lahnakoski et al., 2014). Intersubject correlation (ISC) is a common and well-established neural synchrony approach (Hasson et al., 2004; Nastase et al., 2019) used to identify brain activity shared by participants or groups of participants. As a model-free approach, ISC is data-driven in that it does not assume which features of a stimulus are driving variance in brain activity, and in this way departs from GLM-based analyses or parametric approaches.

Analytically, ISC is fairly straightforward. The response time course within any voxel or channel may be considered a mixture of three signals: 1) signal that is stimulus-triggered and consistent across subjects; 2) idiosyncratic signals triggered by the stimulus; and 3) spontaneous activation. The first, shared signal, can be determined by calculating pairwise correlations between all participants, which will produce an intersubject correlation matrix. After computing a summary statistic of all pairwise correlations for all regions or channels of interest, hypothesis testing can be performed using non-parametric approaches. A full description of this procedure is well-documented elsewhere (Nastase et al., 2019; Chang et al., 2021). Notably, ISC also serves as the basis for more sophisticated analyses used to examine how particular behaviors or subjective indices shape shared neural representations (Finn et al., 2020).

Present Research

The U.S. continues to show an upward trend in political polarization, characterized in part by the perceived division of moral values along party lines (Finkel et al., 2020). This moralization of political identity has contributed to the escalation of negative emotions (e.g., fear, anger, and hatred) directed towards political outgroup members. In turn these negative emotions sustain political divisions by motivating the avoidance of — and even violence towards — opposing partisans (Iyenger et al., 2019). Although negative emotions are potent motivators

of political intolerance, these emotions are nevertheless subject to regulation (Mackie et al., 2008; Halperin et al., 2011). Accordingly, there has been a recent increase in research examining the regulation of political intergroup emotions (Halperin & Schori-Eyal, 2020), with most studies focusing on the benefits of cognitive reappraisal (CR) (Gross et al., 2002). However, the ability to engage in CR appears to be limited in high-arousal emotional contexts (Shafir et al., 2015), and even when effective, may include the tradeoff of reducing political engagement (e.g., information seeking and discussion, monetary donation, etc.) (Ford et al., 2019). These limitations invite the investigation of alternative emotion regulation (ER) strategies that help to manage negative emotions in political contexts without attenuating motivation for democratic engagement (Ford & Feinberg, 2020).

Among promising ER alternatives is mindfulness, a sustained attention to present-moment experiences with an attitude of non-judgmental acceptance (Kabat-Zinn, 2009). Mindfulness training (MT) improves awareness of psychological states, thus enabling the recognition of emotions and biased cognitions (Bishop et al., 2004). Coupled with this awareness, MT-driven improvements in attentional flexibility (Hölzel et al., 2011) may facilitate the disruption of automatic emotional reactivity when faced with morally triggering events (Sevinc & Lazar, 2019). These MT-related changes in attentional functioning have crucial implications for socioemotional processes, including the enhancement of perspective-taking skills (Grecucci et al., 2015) necessary to challenge emotion-laden cognitive distortions associated with partisan opponents. In sum, the distinctive attentional skills conferred by MT may disrupt habitual reactions to political information, and by extension, promote more benign attitudes about partisan opponents. Indeed, emerging research — building on extensive work supporting adaptive mindful regulation of emotion in intra- and interpersonal contexts (DeSteno

et al., 2018; Alkoby et al., 2019; Quaglia et al., 2015; Quaglia et al., 2019) — suggests that MT can reduce partisan biases by down-regulating negative emotions (Alkoby et al., 2017), and such effects may reflect broader changes in moral processing. This line of research is just beginning however (Pandey et al., 2018; Xiao et al., 2020), and the proposed research is designed to rigorously examine the effects of MT on emotional and cognitive responses to morally salient political content. To address this goal, this study will take a multimethod approach to examine training-related responses to political stimuli.

The proposed randomized controlled trial (RCT) examines the effects of short-term Mindfulness Training (MT) *vs* structurally equivalent active coping training (CT) emphasizing cognitive reappraisal on political intergroup emotions, explicit intergroup attitudes, and moral information processing among self-reported U.S. Democrat voters. Intergroup negative emotions will be elicited using a validated naturalistic viewing paradigm (Ford et al., 2019) in which partisan news clips are used to experimentally induce negative moral emotions in Democratic voters. This study has three aims:

Specific aim 1. Does Mindfulness Training (MT) relative to structurally equivalent active coping control (CT) reduce negative emotion reactivity to political stimuli (news videos)?

Specific aim 2. Does MT, relative to CT, alter explicit attitudes about political outgroup members following exposure to political-content videos?

Specific aim 3. Do individuals trained in MT vs. CT exhibit different neural representations of political content?

Methods

Participants

The study design and hypotheses were pre-registered with clinical trials identifier NCT04190030 and OSF registries (https://osf.io/htdc7). All study procedures were approved by the Virginia Commonwealth University IRB. Data collection took place between July 2021 and April 2022. Given the novelty of this line of research, power for sample size determination was based on analyses of the proposed neural outcomes. Desmond and Glover (2002) have recommended sample sizes of 20 – 30 subjects for whole-brain analysis to replicate across samples. Recent fNIRS research suggests that sample sizes of 60 - 75 are powered to detect two-group differences in PFC neural synchrony.

Participants were 60 healthy community adults recruited from the Richmond Virginia area (M = 28.53, SD = 8.76; see Table 1. for baseline characteristics). Prospective participants were screened for inclusion via an internet-administered survey. Inclusion criteria included proficiency in the English language, Democrat candidate-voting status, smartphone ownership (iOS or Android OS), absence of a new (non-acute) diagnosis of a medical or psychiatric condition within the last 3 months, and limited prior exposure to cognitive- or mindfulness-based training (practice < 2 times per week within the past 3 months). Prospective participants were excluded if they reported substance abuse/dependence or baseline stress levels <5 on the 4-item Perceived Stress Scale (PSS).

Prior to data collection, condition randomization was conducted using block randomization (https://www.randomizer.org/) by a research team member who did not interact with any participant. Program allocations were written and stored in separate sealed envelopes labeled with a study ID number only. Program assignment was revealed to the participant in the

first lab session following pre-training data acquisition, during which an undergraduate research assistant (RA) or graduate research assistant (GRA) opened the appropriate envelope. Program assignment was then recorded in an encoded dataform and the envelope was destroyed. See Figure 1. for a CONSORT flowchart.

To introduce participants to their training program and to equalize training expectancies, each participant viewed the same 5-minute introductory video explaining how to prepare for and what to expect in their training program. Immediately after viewing the video, each participant completed a brief self-report survey of training expectancies, the Credibility Expectancy Questionnaire (CEQ; Devilly & Borkovec, 2000). Preliminary analysis determined that MT and CT groups did not differ significantly in credibility/expectancy, $t(58) = 1.37$, $p = .193$.

Table 1.

	Mindfulness (n = 26)	Active Coping (n = 34)	
	M (SD)	***M (SD)***	***P***
Age	29.31 (8.84)	27.94 (8.78)	.82
Liberal Affiliation	5.85 (.83)	6.09 (.79)	.89
1 (extremely conservative) - 7 (extremely liberal)			
	n (%)	***n (%)***	***P***
Gender			
Cis-woman	22 (84.61)	24 (70.59)	.32
Cis-man	3 (11.53)	7 (20.59	
Non-binary	0 (0)	3 (8.82)	

Race/ethnicity			
White	16 (61.54)	21 (61.76)	
Black/African American	3 (11.53)	5 (14.71)	
Hispanic or Latino	2 (7.69)	2 (5.88)	
East Asian	2 (7.69)	4 (11.76)	
Southeast Asian	4 (15.38)	5 (14.71)	
Marital Status			
Married	8 (30.77)	8 (23.53)	.76
Divorced	2 (7.69)	2 (5.88)	
Never Married	16 (61.54)	24 (70.59)	
Annual Household Income			
Less than $25,000	8 (30.77)	7 (20.59)	.50
$25,000 - $39,000	2 (7.69)	7 (20.59)	
$40,000 - $54,000	3 (11.53)	2 (5.88)	
$55,000 - $69,000	5 (19.23)	2 (5.88)	
$70,000 - $84,000	2 (7.69)	2 (5.88)	
$85,000 - $99,000	1 (3.85)	4 (11.76)	
$100,000 - $114,000	0 (0)	1 (2.94)	
$115,000 - $129,000	0 (0)	2 (5.88)	

$130,000 - $144,000	2 (7.69)	2 (5.88)	
$145,000 - $159,000	0 (0)	1 (2.94)	
$160,000 or more	3 (11.53)	4 (11.76)	
Education			
Graduated high school	1 (3.85)	1 (2.94)	.53
Some college/no degree	3 (11.53)	9 (26.47)	
Associate's degree	1 (3.85)	0 (0)	
Bachelor's Degree	13 (50.00)	15 (44.12)	
Post-graduate degree	8 (30.77)	9 (26.47)	

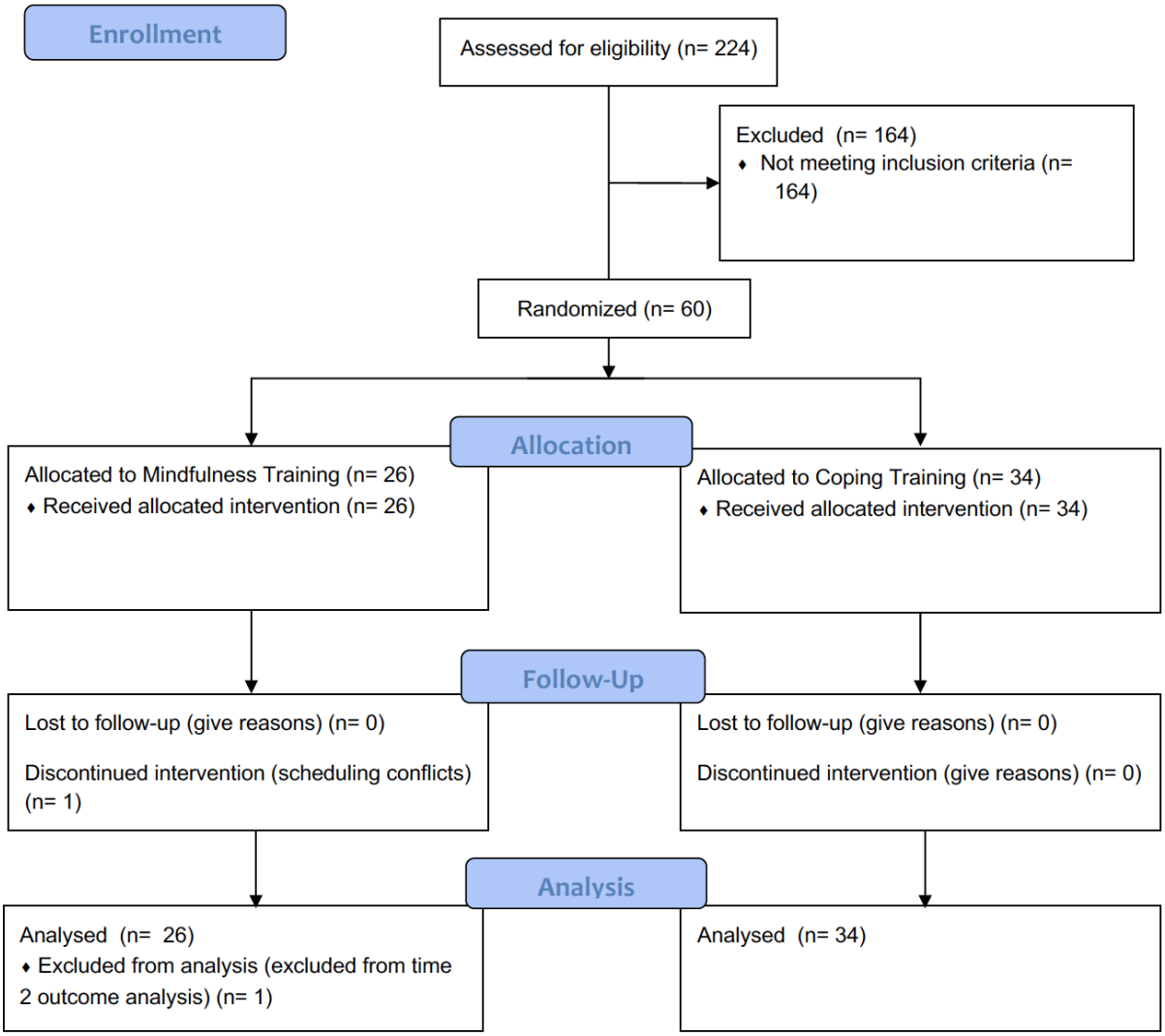

Figure 1. CONSORT flowchart.

Procedure

Following successful enrollment, participants completed a baseline lab visit, including study orientation, provision of informed consent, and completion of self-report questionnaires assessing individual differences in emotion regulation and intellectual humility. Hemodynamic responses were then recorded via fNIRS while participants underwent a naturalistic viewing task. Upon completing all baseline measures, participants were randomized to one of two structurally

equivalent 14-day digital interventions (MT or CT). Following training completion (< 3 days after completing final lesson), participants attended a second lab session, during which they again underwent continuous fNIRS recording to assess cortical hemodynamic responses during a naturalistic viewing paradigm. Finally, participants completed a final survey packet through which explicit attitudes towards political outgroup members were assessed.

Naturalistic Viewing Paradigm

The present study adapts an ecologically valid viewing paradigm (Ford et al., 2019) shown to experimentally induce negative emotions in Democratic voters. In order to induce negative emotion, participants viewed a series of political partisan videos and emotionally neutral videos for control comparison. All videos were validated for emotionality in an independent sample of U.S. Democratic voters. Procedures for the naturalistic viewing paradigm were as follows: four emotionally neutral and four emotionally negative video clips (approximately 1-3 minutes in length) were block-order randomized (at the participant-level) and presented to participants sequentially. Audio was delivered via headphones. Immediately following individual videos, participants rated emotion reactivity across five emotions—joy, anger, fear, disgust, sadness—via a digital affective slider (scaled 0-100) (Betella & Verschure, 2016). For the purposes of this study, emotion scores were aggregated across each video type (i.e., control and experimental trials). To test the specificity of the stimuli on emotional reactions and to reduce pre-post-training carryover effects, the political video stimuli were embedded in an order-randomized, brief series of neutral video stimuli. Video order randomization, stimuli delivery and behavioral data acquisition were completed using PsychoPy® software (Peirce, 2019).

Functional Near-Infrared Spectroscopy (fNIRS)

Neural responses to video stimuli were assessed using fNIRS (NIRSport imaging unit from NIRx; nirx.net/nirsport), a neuroimaging modality suited to detect hemodynamic response as a spatially-sensitive indicator of brain function. Spatial positioning of light sources and detectors is standardized using the 10-10 UI external positioning system and light intensity data is collected at wavelengths of 760 and 850 nm and a sampling rate of 7.8 Hz. An elastic cap was used to affix eight light sources and eight detectors positioned according to a 20-channel prefrontal cortical montage. Positioning of nodes and location of channels in 3D cortical space are displayed in Figure 2. This prefrontal arrangement is optimally suited for detecting activation from dorsolateral and medial prefrontal cortical structures (Burns et al., 2018). NirsLAB software was used to test optode saturation levels and ensure signal quality prior to data acquisition. Approximate anatomical locations of each channel are displayed in Appendix 1.

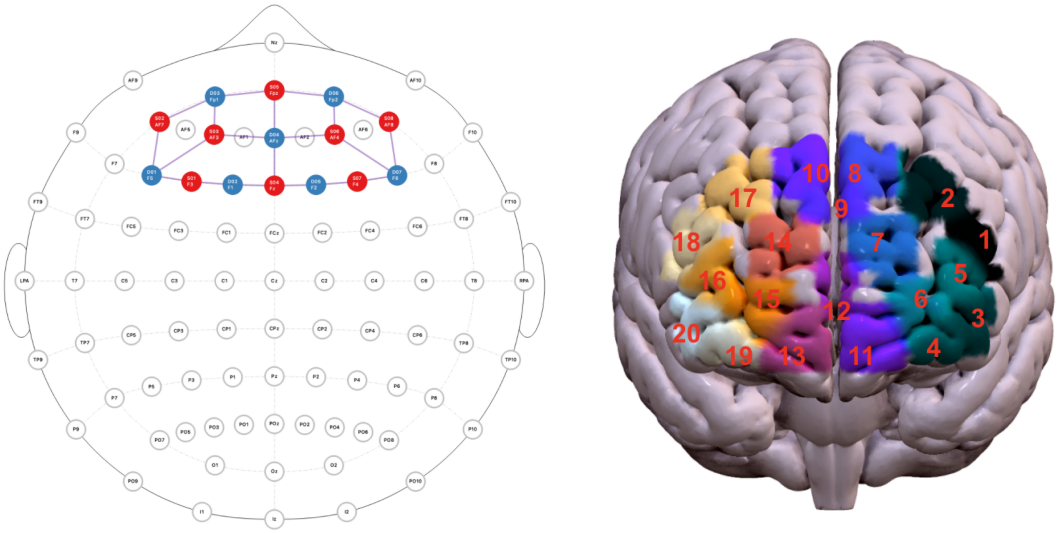

Figure 2. The left panel depicts a standardized prefrontal cortical montage with the positioning of light sources (red) and detectors (blue). Source-detector channels were mapped to 20 regions of interest (ROIs) and transposed on a 3D cortical surface (right panel).

Materials

Stimulus Development

Video editing software was used to edit video clips to a duration of 1-3 minutes and conceal logos shown on screen (given the potential for network or product logos to bias participant responses). A total of 10 experimental and 10 control video stimuli were prepared and examined for validity. Stimulus validation was assessed using a sample of 203 Democratic-voting U.S. citizens recruited through Prolific (prolific.co). Participants passively viewed and rated all video clips for emotionality (i.e., arousal, pleasure) using a sliding scale (0-100). Exploratory factor analyses (EFA) were conducted to identify videos fitting a two-factor structure (i.e., experimental and control). Prior to analyses, variables were checked for univariate and multivariate normality and outliers of +/- 3 SD were winsorized. Two EFA's were performed using a Promax rotation including 12 items to assess the structure of emotional arousal and 12 items to assess the structure of emotional (dis)pleasure. Inspection of scree plots and factor loadings suggested a two factor structure with 8 items loading meaningfully onto each factor (eigenvalues exceeding .50; DeVellis & Thorpe, 2021). Thus, we identified 8 experimental and 8 control videos; half of each type were presented at the pre-training lab and half of each type were presented at follow-up.

Interventions

The Mindfulness Training and Active Coping training programs were developed and validated as part of a three-pronged randomized controlled trial that aimed to isolate monitoring and acceptance components of mindfulness while controlling for nonspecific training features (Lindsay et al., 2018a). Both interventions were structurally equivalent and delivered by the same instructor. Each program included daily audio lessons of 15-20 minutes in length and daily brief, experiential homework assignments (3-10 minutes per day). Each audio lesson trained

specific techniques through didactic explanation, guided practice, and self-guided practice. Research assistants contacted participants by phone on days 3 and 9 of the intervention program to address difficulties or training-specific questions and encourage participant adherence. Research assistants also monitored daily progress through the program to ensure lesson compliance, and participants were encouraged to text or call the study hotline to ask questions or resolve technical issues. If participants failed to complete a lesson, they were instructed to complete the previous day's lesson before continuing with the scheduled lesson. Participants who missed two consecutive lessons were instructed to follow a two-lesson schedule for two days. Participants who missed three consecutive lessons were contacted to determine possible discontinuation from the study. Thus, all participants who completed post-training measures completed the full 14-day lesson schedule.

Mindfulness Training (MT)

Mindfulness participants first learned foundational concentration skills that enabled them to (1) monitor their present-moment body experience (in the lessons, this skill was referred to as 'sensory clarity') while (2) welcoming and accepting each experience (referred to as 'equanimity'). Monitoring ('sensory clarity') was explained in terms of two dimensions: resolution (discriminating types of experiences; e.g., pleasant, unpleasant, neutral; physical vs. emotional) and sensitivity (i.e., detecting subtle sensations). Acceptance ('equanimity') was trained through three tangible strategies that embodied the attitude of acceptance: participants were encouraged to (a) maintain a state of global body relaxation, (b) mentally welcome all physical and emotional body experiences, and (c) use a gentle, matter-of-fact tone of voice (an 'equanimity tone') while labeling these experiences.

Active Coping Training (CT)

The active coping program was developed to parallel the structure of Mindfulness training without encouraging focus on or acceptance of present experience. Instead, participants were instructed to reframe or reappraise past and anticipated events (with past and future emphasis contrasting present-focused monitoring, and change strategies contrasting acceptance strategies), and analyze and solve personal problems (again encouraging active change rather than acceptance of momentary experiences). The active coping program was designed to be useful for managing stress (reinforcing common reappraisal and problem solving strategies) without promoting mindful emotion regulation strategies.

Behavioral Outcomes

Emotion Reactivity

Discrete emotions. Immediately after each video, the Discrete Emotions Questionnaire (Harmon-Jones et al., 2016), delivered via the validated Affective Slider digital scale (Betalla & Verschure, 2016), was used to assess anger, disgust, fear, sadness, and joy. The sliding scale was presented on screen with the anchors, 0 (no emotion) to 100 (an extreme amount of emotion), and tick marks placed at 10 point increments. Participants were allotted 5 seconds to rate each emotion before proceeding to the next scale. To ensure understanding of and compliance with the procedure, participants completed a practice round in which they viewed and rated emotional reactions to the classic Charlie Chaplin 'Roller Skating' scene from the film, *Modern Times*.

Intergroup Attitudes

Affective prejudice. Affective prejudice towards political outgroup members was assessed using a validated sliding scale (Moore-Berg et al., 2020), in which participants rated feelings of warmth towards target groups on a scale of 0 (cold/unfavorable) to 100 (very warm/favorable). Target groups included Democrats, Republicans, and distractor groups

(Americans, undocumented migrants, and Europeans). Prejudice was calculated using the difference score (ingroup-outgroup) so that high scores indicated greater affective prejudice towards the political outgroup.

Social Distancing. This social distancing scale, adapted from Moore-Berg et al. (2020) examined desire to remain separate from political outgroup members. Participants answered three items to indicate how comfortable they would feel if a political outgroup member was their doctor, their child's teacher, or their child's best friend. The sliding scale ranged from 0 (not at all comfortable) to 100 (very comfortable). Thus, higher scores reflected lower desire for social separation.

Behavioral Intention. Willingness to interact with a conservative/Republican voter (and liberal/Democratic voter) was assessed at the post-training lab visit only. Following fNIRS recording and questionnaire completion, participants were invited to join an ostensible future experiment in which they would discuss current political issues with a partner. The measure is used to determine willingness to engage in intergroup contact (Halperin et al., 2011). Participants were asked "If we asked you to take part in such a study, who would be your preferred conversation/debate partner?" Participants then completed a single-item measure (adapted from Halperin et al., 2012) in which they rated the extent to which they would prefer to have a partner that is (a) a right-wing, Republican conversation partner and (b) a left-wing Democratic conversation partner (on a scale of 1, *not at all,* to 6, *a very large extent*).

Potential for Change. 'Beliefs about groups', a construct assessed in previous studies of intergroup emotion (Halperin et al., 2011), uses four items to measures group malleability beliefs (example item: "As much as I hate to admit it, you can't teach an old dog new tricks — certain

groups can't really change their basic characteristics.") on a scale from 1, *strongly disagr*ee, to 6, *strongly agree*.

Baseline Covariates

Political Polarization

Partisan self-identification was measured using a 1-item questionnaire in which participants rate their political views on a scale of 1 (very liberal) to 7 (very conservative).

Mindful Attention Awareness Scale

A basic form of trait mindfulness was measured using this 15-item scale (sample α = .88) assessing receptive attention to, and awareness of present moment stimuli. Participants rated items (e.g., "I find it difficult to stay focused on what's happening in the present") on a scale from 1 ("almost always") to 6 ("almost never"), with higher scores indicating higher levels of mindfulness. Dispositional mindfulness was calculated from the average of the 15 items. In previous reports, the MAAS has shown strong internal consistency and test-retest reliability and has shown to be significantly associated with enhanced self-awareness (e.g., Brown & Ryan, 2003).

Intellectual Humility

Research suggests that intellectual humility in the sociopolitical domain may buffer against affective polarization, ostensibly via reductions of defensive attitudes (Krumrei-Mancuso & Newman, 2020) (sample α = .71). Accordingly, the present study measured intellectual humility in socio-political matters (Krumrei-Mancuso & Newman, 2020), defined as the degree of non-threatening awareness of fallibility of one's political views. Using a 22-item questionnaire, participants rated the degree to which they agree with each statement on a scale of 1 (strong agree) to 5 (strongly agree). Example items include 'I am open to revising my

important beliefs in the face of new information' and 'I welcome different ways of thinking about important topics'.

Emotion Regulation

Affective Styles. The affective styles (AS) questionnaire (Hofman & Kashdan, 2010) assesses individual tendencies to manage emotions through concealing (sample α = .88), adjusting (sample α = .84), or tolerating (sample α = .66) emotional experiences. This scale includes 20 Likert-scaled items (1 = not true of me at all; 5 = extremely true of me).

Emotion Regulation Goals. The 18-item Emotion Regulation Goals scale (ERG; Eldesouky & English, 2018) was used to determine motives and goals related to regulation of negative emotion. The ERG is composed of two dimensions, hedonic goals (i.e., motivations to feel better) and instrumental goals (i.e., motivations to meet personal or social needs), which can further be subdivided into 5 dimensions: prohedonic (sample α = .76), contra-hedonic (sample α = .77), performance (sample α = .79), prosocial (sample α = .81), and impression management goals (sample α = .91).

Beliefs about Emotion. Beliefs about emotion (Rimes & Chalder, 2010) measured beliefs about negative emotions, specifically regarding the acceptability and controllability of negative emotions (sample α = .89). In this questionnaire participants rate 12 statements on a scale of 6 (totally agree) to 0 (totally disagree), with higher scores indicating beliefs that it is inappropriate to feel or express negative emotions.

Anger-related Reaction and Goals Inventory (ARGI). Thes ARGI (Kubiak et al., 2011) is a two-part, 51-item instrument used to evaluate functional and dysfunctional anger reactions and the goals motivating the regulation of anger. The dimensions of anger-related reactions include feedback (sample α = .80), distraction (sample α = .79), downplaying (sample

α = .63), humor (sample α = .93), venting (sample α = .75), rumination (sample α = .87), and submission (sample α = .93). The dimensions of anger regulation goals include enforcing personal standards (sample α = .83), enforcing social norms (sample α = .80), regulating affect (sample α = .72), protecting reputation (sample α = .77), weighing costs (sample α = .75), avoiding conflicts (sample α = .91), and taking revenge (sample α = .75). Among these subscales, giving *feedback* in the face of anger has shown to be the most adaptive reaction for social-emotional wellbeing (Deffenbacher, 2006). Unlike venting, rumination, or submission, clearly communicating anger is related to decreased distress response and faster physiological recovery (Kubiak et al., 2011). Moreover, anger feedback can be distinguished from distraction or cognitive reframing responses, which—while conducive to mitigating distress—eschew the need to constructively approach the source of anger provocation (Kubiak et al., 2011).

Data Analyses

fNIRS preprocessing

Neural timecourses for each video were trimmed and concatenated by video type, resulting in 2 neural timecourses for concatenated political and neutral video clips. Raw fNIRS data were preprocessed using a Matlab wrapper function (Burns, 2018, MIT License) with Homer2 analysis package dependencies (Huppert et al., 2009). The preprocessing pipeline first trims the time course to remove additional scan time before or after the presentation of stimuli. Then, channels with excessive noise are identified and channels are labeled “unusable” if detector saturation occurs for more than 2 seconds or if the signal’s power spectrum resembles white noise (i.e., the quartile coefficient of dispersion < .1). NIRS data are then filtered using a bandpass filter of .005-.5 Hz and are corrected for motion artifacts via PCA algorithm. The resulting signals are converted to hemoglobin concentrations relative to baseline using the

Modified Beer Lambert Law and z-scored. Finally, a Pearson's correlation is used to examine remaining measurement errors among signals of each channel. Neuroimaging analyses were conducted on standardized total oxygenated-deoxygenated hemoglobin (HbO - Hb) concentrations.

A probabilistic registration method (Singh et al., 2005) was used to estimate approximate MNI coordinates for each channel position. This method has previously been used to localize fNIRS data to common 3D brain space, thus enabling cross-modal comparison with data obtained through fMRI (Tsuzuki et al., 2007). Data was converted to *img files using xjView and overlaid on a 3D cortical surface via Surf Ice software. Figure 2 displays the location of each channel in 3D brain space.

Specific Aim 1. The Impact of Training on Emotion Reactivity to Political Stimuli

The impact of training assignment on emotion reactivity was examined via multilevel modeling (MLM) based on restricted maximum likelihood estimation (REML; e.g., Bryk & Raudenbush, 1992). Using the nlme package in R (v3.1-152; Pinheiro et al., 2021), multilevel analyses were conducted for five discrete emotions: anger, disgust, fear, joy, and sadness. Pre-training emotion scores were modeled as fixed and random effects, and intercepts and slopes were allowed to covary. Choice of most appropriate between-subjects variance-covariance structure (unstructured, Toeplitz, variance components) was determined through chi-square tests comparing the -2 restricted log likelihood model fit indices. An unstructured variance-covariance structure was supported. Data were pretreated such that outliers (> 2.58 SD) were winsorized and continuous predictor variables were centered around zero. The training assignment variable was scored as 0 (active coping) and 1 (mindfulness). To examine the effect of intervention on change on emotion reactivity, post-training emotion scores were regressed on pre-training

emotion scores, training assignment, and their interaction. Follow-up post-hoc multilevel analyses were conducted to control for baseline covariates of theoretical import, specifically pretreatment scores in anger response style and intellectual humility.

Specific Aim 2. The Impact of Training on Explicit Intergroup Attitudes

The effect of training assignment on explicit intergroup attitudes was analyzed using the multilevel modeling procedure described above. MLM analyses were conducted for three outcomes of interest: affective prejudice, social distancing, and willingness to interact with a conservative/Republican voter. Chi-square tests comparing -2 restricted log likelihood supported the use of an unstructured variance-covariance structure. Follow-up post-hoc multilevel analyses were conducted to control for baseline covariates regarding intellectual humility and anger response style.

Specific Aim 3. The Impact of Training on Neural Representations of Political Content

Analysis of fNIRS data applied two neural synchrony approaches, intersubject correlation (ISC) and representational similarity analysis (RSA) using a customized python-based script (naturalistic-data.org) adapted for fNIRS. Time courses of total oxygenated hemoglobin (total-oxy) were z-scored and concatenated to match the sequence of video order. Time courses were analyzed for 52 participants (MT n = 22, CT n = 30) across 20 channels.

Intersubject Correlation (ISC)

An intersubject correlation (ISC) approach was used to determine if training groups exhibited significantly different patterns of neural synchrony while viewing highly emotional politically partisan videos. ISC is a data-driven technique developed to identify neural regions in which activity systematically fluctuates for participants exposed to the same time-locked stimulus (Hasson et al., 2010). Within a single subject, activity in a neural region, $X_A(t)$, may be

considered a combination of activation commonly shared across participants, $\alpha_A C(t)$, idiosyncratic activity, $\beta_A id_A(t)$, and noise driven by indeterminate sources, $\varepsilon_A(t)$. This relationship is represented with the formula:

$$X_A(t) = \alpha_A C(t) + \beta_A id_A(t) + \varepsilon_A(t)$$

Shared activity, or s*ynchrony*, can be estimated by averaging $X_A(t)$ between many pairs of subjects, producing a subject-by-subject correlation matrix. Regions with significant time-locked synchrony can be inferred as relevant for shared information processing, ranging from basic sensory perceptions to the interpretation of complex social emotional stimuli.

While such a *pairwise approach* is recommended as the first-level analyses prior to one-sample group-level analyses, a variation of this approach—referred to as a *leave-one-out approach* is ideal for two-sample tests (Nastase et al., 2019). In contrast to a pairwise approach, a leave-one-out approach estimates individual-level ISC values (X_A) using the average time course of every subject *with the exception of the subject's own time course data*. Accordingly, a given group's ISC value may be described as:

$$ISC_{Group} \sim r(X_A , \underline{X}_{Group \neq A})^2$$

Given that the aim of this study is to identify group-level differences (i.e., mindfulness *versus* active coping trainees) in neural synchrony, ISCs for each channel were calculated using a leave-one-out approach (Hall & Wilson, 1991).

Group-level inferential testing is complicated due to intercorrelations of ISC coefficients, which violate assumptions of statistical independence (Chen et al., 2016). To address this concern, Chen et al. (2016) conducted simulation analyses to test the statistical validity of a series of non-parametric approaches in respect to controllability of false positive rates (FPR) and power. Accordingly, Chen et al. (2016) recommended that between-group comparisons be tested

indirectly by comparing the difference between within-group ISC and between-group ISC matrices:

$H_0 : ISC_{within} = ISC_{between}$

This may be accomplished through subject-wise permutation (SWP), which compares centrality of observed data to that of a null distribution, generated by randomly reassigning group membership over a number of iterations (typically 5000). In accord with recommended procedures for FPR controllability, subject-level hypothesis testing was conducted using SWP (Chen et al., 2016) in order to identify channels with significant within-group synchrony (one-sample analyses) and significant within- *versus* between-group synchrony (two-sample analyses).

Intersubject Representational Similarity Analysis (RSA)

ISC may be leveraged to capture brain activity driven by a time-locked stimulus, even when such activity reflects nuanced interpretations of complex social-emotional information (Hasson et al., 2004). However, the nature of such interpretations remains ambiguous without statistical approaches suited to detect brain-behavior relations. This limitation may be accounted for by adapting the logic of ISC to an individual differences framework, an approach referred to as Intersubject Representational Similarity Analysis (IS-RSA) (Finn et al., 2020). Given that behavior-dependent signal may be derived from idiosyncratic activity, $\beta_A id_A(t)$, IS-RSA is positioned to triangulate sources of idiosyncratic neural signal. More specifically, IS-RSA compares (dis)similarity structures of brain and behavior data, operationalized as the Euclidean distance between each pair of subjects' time courses or behavioral scores. Where $c_1(t)$ is the stimulus-evoked response for subject 1 and $c_2(t)$ is the stimulus-evoked response for subject 2, a pairwise distance may be expressed as the following:

$$D = \sqrt{\Sigma_t (c_1(t) - c_2(t))^2}$$

Iterated over all pairs of subjects, this calculation produces a Representational Dissimilarity Matrix (RDM) of intersubject Euclidean distances for the neural time course of each region and each behavioral measure of interest. It warrants noting that Euclidean distance metrics assume a particular brain-behavior similarity structure in which subjects rank-ordered by behavioral scores are most similar to their immediate neighbors (Finn et al., 2020). This structure is referred to as a Nearest Neighbor (NN) model and may be contrasted with an Anna Karenina (AnnaK) model—named for Tolstoy's opening line: "All happy families are alike; each unhappy family is unhappy in its own way" —and assumes that brain-behavior similarities increase monotonically. Thus, while a NN model uses a Euclidean distance metric, an AnnaK model uses a distance metric based on absolute position (e.g., the mean of two subjects' rank divided by the number of subjects). For demonstration, examples of NN and AnnaK similarity structures were generated using anger reactivity scores and neural time courses elicited from the political video viewing task (see Figures 3 and 4). Determining which similarity structure (and by extension, distance metric) is most appropriate is accomplished by conducting IS-RSA with both NN and AnnaK models and inspecting models for differences in representational similarity, either statistically or visually. For example, the distribution of brain-behavioral similarities by region may be visually compared by histogram and scatter plot (as demonstrated in Figure 5) or the mean of both distributions may be compared via paired-sample t-test. Finally, hypothesis testing is performed by correlating the upper triangles of brain and behavioral similarity matrices and conducting subject wise permutation (SWP), as recommended for FPR controllability (Finn et al., 2020).

In the present study, inter-subject representational similarity analyses (IS-RSAs) were used to determine if neural similarities were indicative of shared social-emotional experiences or perceptions of political outgroup members. First subject-by-subject inter-subject similarity matrices were calculated from fNIRS time courses and behavioral scores. In the present study, the primary behavioral scores of interest were discrete emotions (i.e., joy, anger, fear, sadness, and disgust) and political outgroup prejudice (i.e., affective prejudice and social distance). Similarities in the structures (of variations) of behavioral pairwise correlations and neural ISC were examined using a Mantel test. Nearest neighbor (NN) and Anna Karenina (AnnaK) models were then compared for best fit using a paired-samples t-test and scatterplot examination. Finally, I tested for significant neural representation of behavioral scores using non-parametric hypothesis testing with 5000 permutations and Bonferroni correction ($p = .05$, $k = 5$).

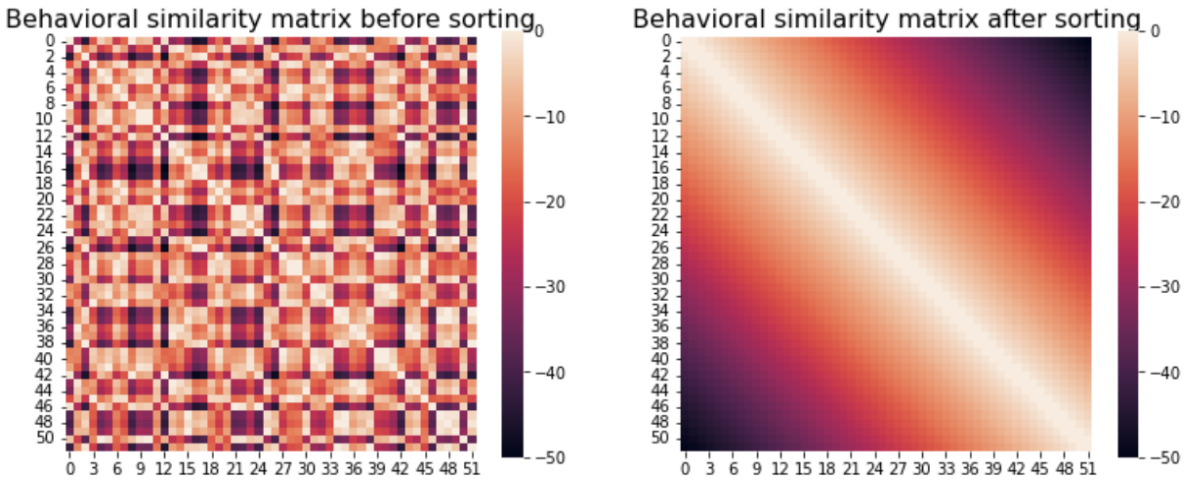

Figure 3. Behavioral similarity matrices of anger reactivity scores before and after sorting into a nearest neighbors (NN) model.

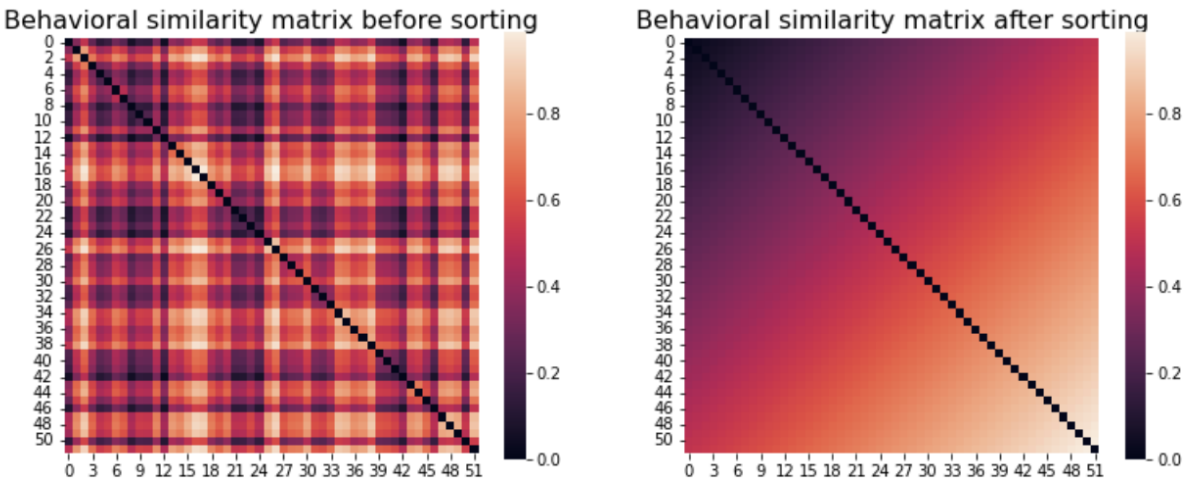

Figure 4. Behavioral similarity matrices of anger reactivity scores before and after sorting into a Anna Karenina (AnnaK) model.

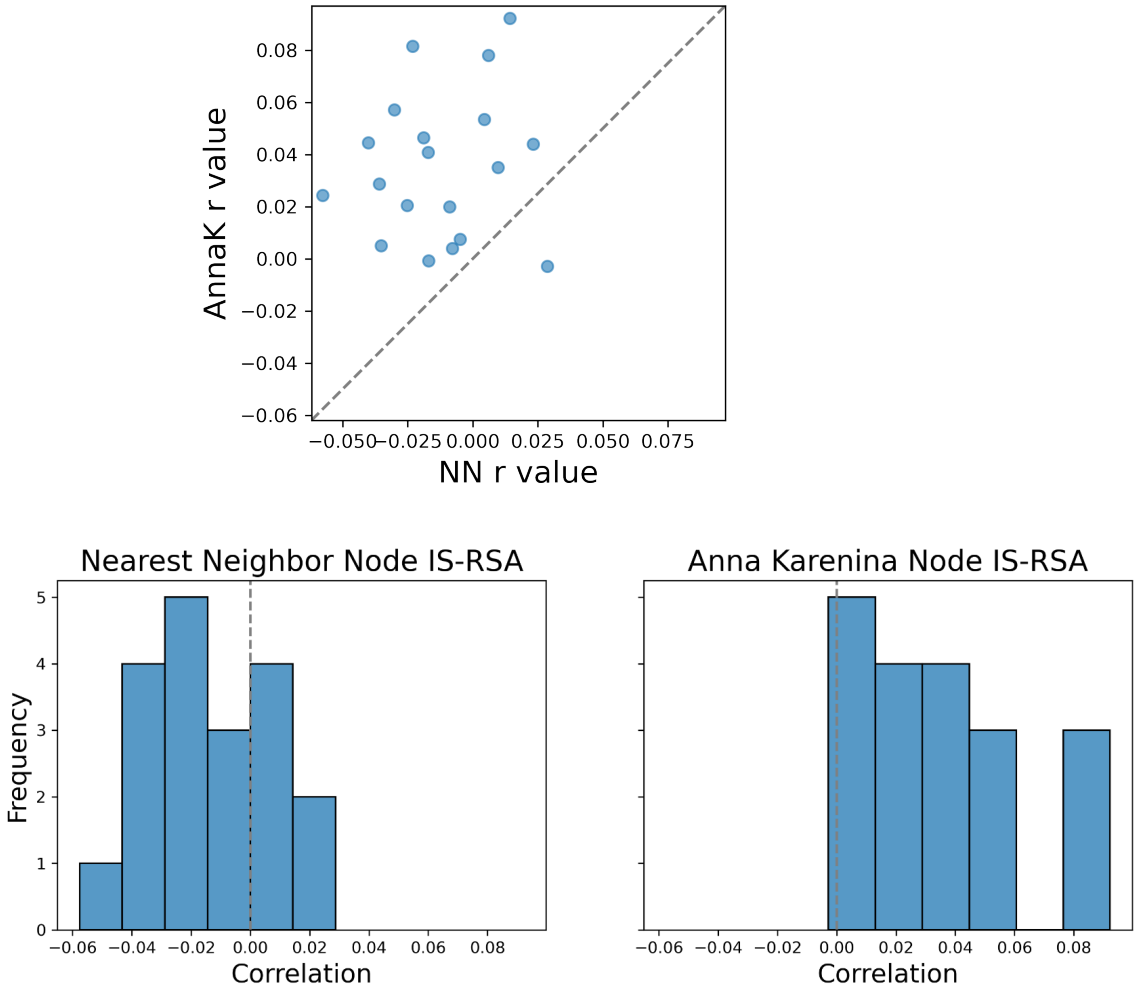

Figure 5. Plots display brain-behavioral similarity values based on anger reactivity scores. Nearest Neighbor (NN) and AnnaK similarity models are compared using visual inspection of scatterplot (top) and histogram (bottom). Plots suggest that an AnnaK model would more aptly measure representational similarity for the majority of channels given that scatterplot points fall predominantly above the identity line and that AnnaK model exhibits a distribution of coefficients shifted in the positive direction.

Results

Preliminary Analyses

As a manipulation check, a two-way ANOVA was conducted to ensure that political videos effectively elicited negative emotion relative to neutral control videos. Simple slopes suggested that the experimental manipulation was effective (see Figure 6); relative to neutral videos, political videos elicited greater anger ($F(1) = 749.78$, $p < .001$), disgust ($F(1) = 877.64$, $p < .001$), fear ($F(1) = 262.53$, $p < .001$), and sadness ($F(1) = 446.80$, $p < .001$). In contrast, neutral videos scored higher in joy compared to political videos, $F(1) = 330.21$, $p < .001$.

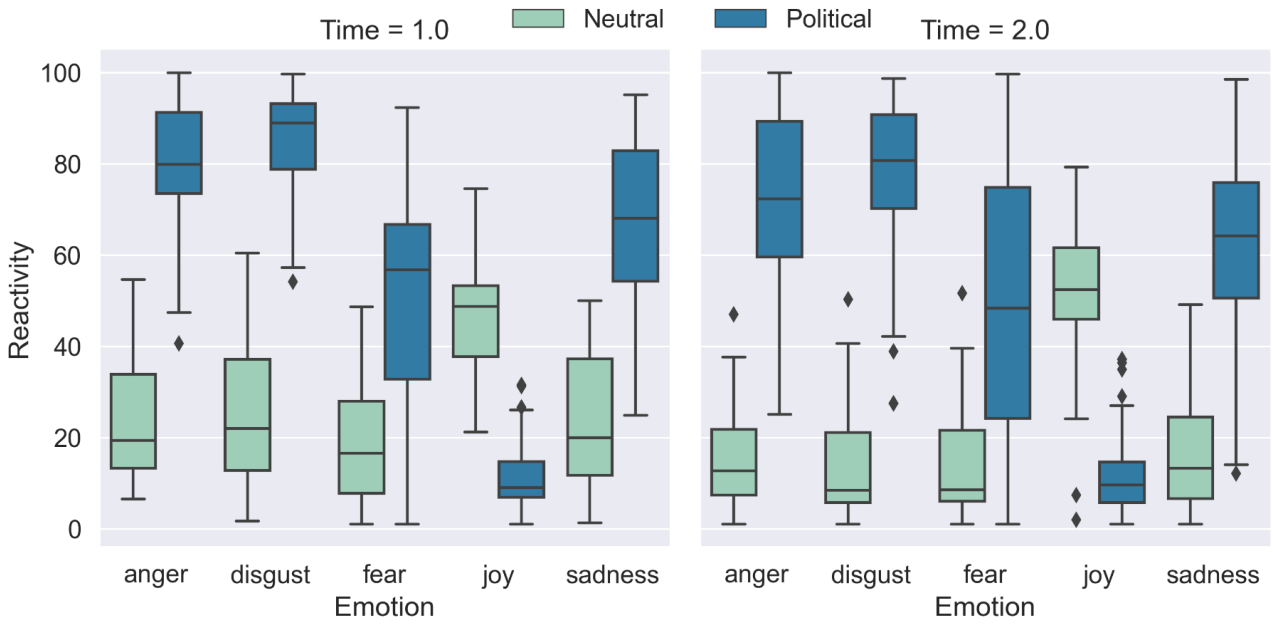

Figure 6. Descriptive plots of emotion reactivity scores across video type (neutral *vs* political) and emotion category (anger, disgust, fear, joy, and sadness) shown at pre-training (Time = 1) and post-training (Time = 2).

A series of analyses were conducted to establish group equivalence at pre-training. Independent samples t-tests determined that prior to training, participants assigned to receive mindfulness (MT) or active coping (CT) training did not report significantly different emotion reactivity scores during the political video condition ($p > .05$). Moreover, training groups did not show differences across any trait measures assessed at pre-training (see supplementary tables S1

and S2). Finally ISC analyses were conducted to examine significant neural synchrony within and between groups using pre-training neural time courses during the political video condition. Both MT and CT showed significant within-group synchrony for the majority of channels (see Table 2). These findings suggest that videos reliably elicited shared social-emotional interpretation of videos at the group-level. Tests for within- *versus* between-group ISC did not detect any channels, suggesting that neural synchrony was statistically exchangeable between groups (Nastase et al., 2019).

Table 2.

Control	Mindfulness	Mindfulness ≠ Control
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	1, 3, 4, 6, 7, 9, 12, 13, 14, 15, 18, 19	N/A

The Impact of Training on Emotion Reactivity to Political Stimuli

The remainder of this subsection will exclusively focus on behavioral responses to experimental videos (but see Supplemental Table S3). Summary statistics by training condition and time are shown in Table 3 and Figure 7. Across groups, participants reported significantly less anger ($t(58) = 3.48$, $p < .001$), disgust ($t(58) = 4.12$, $p < .001$), and sadness ($t(58) = 2.31$, $p < .02$) at post-training relative to baseline. MLM analyses examined if changes in emotion reactivity may be attributed to training assignment by regressing post-training emotions scores on pre-training emotion scores, training assignment, and their interaction. These initial models did not suggest a significant main effect or interaction of training assignment on anger, disgust, fear, joy, or sadness (p's > .05).

Table 3. Emotion Reactivity to Political Stimuli

	Pre-training Anger		Post-training Anger	
	CT	**MT**	**CT**	**MT**
Mean	80.53	78.76	74.62	69.25
Std. Deviation	11.35	14.30	20.83	15.76
Minimum	53.04	40.64	25.11	25.50
Maximum	100.00	98.79	100.00	99.17

	Pre-training Disgust		Post-training Disgust	
	CT	**MT**	**CT**	**MT**
Mean	85.86	83.80	79.65	73.14
Std. Deviation	10.65	12.53	16.78	18.10
Minimum	57.64	54.20	27.51	27.51
Maximum	99.66	99.31	98.58	98.67

	Pre-training Fear		Post-training Fear	
	CT	**MT**	**CT**	**MT**
Mean	52.19	51.66	49.53	46.15
Std. Deviation	19.90	28.04	27.24	27.39
Minimum	5.84	1.00	1.00	1.00
Maximum	89.85	92.30	99.63	86.39

	Pre-training Joy		Post-training Joy	
	CT	**MT**	**CT**	**MT**
Mean	11.90	10.98	9.49	15.36
Std. Deviation	8.25	6.26	8.00	9.96
Minimum	1.00	2.67	1.00	3.02
Maximum	31.27	31.54	37.13	37.13

	Pre-training Sadness		Post-training Sadness	
	CT	**MT**	**CT**	**MT**

Mean	67.55	65.99	61.14	60.86
Std. Deviation	16.56	20.71	22.98	23.21
Minimum	37.63	24.87	15.71	12.14
Maximum	95.14	95.14	98.35	98.53

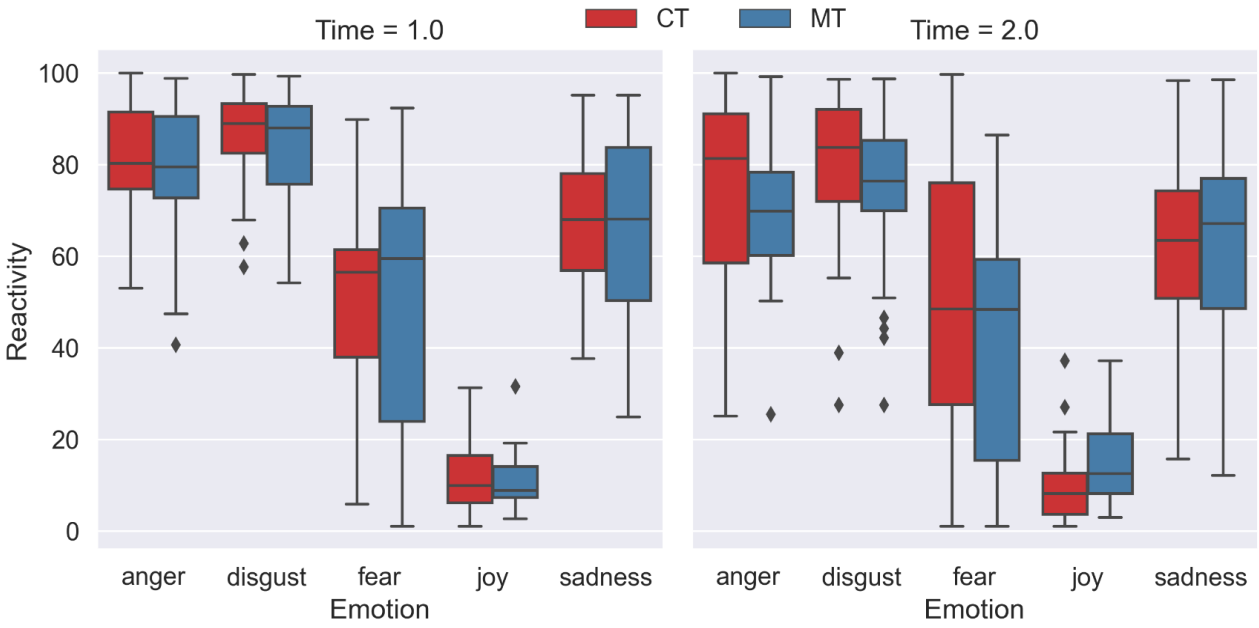

Figure 7. Descriptive plots comparing emotion reactivity scores for anger, disgust, fear, joy, and sadness between mindfulness (MT) and active coping (CT) training groups at pre-training (Time = 1) and post-training (Time = 2).

Given that systems meta-theory assumes interactive effects between individual-level dispositions and group-level influences (Leach & Bou Zeineddine, 202), exploratory post-hoc analyses were conducted to determine if effects of training emerged after controlling for individual-level sources of variability. Among dispositional emotion regulation scores, the feedback scale of the ARGI was consistently correlated with negative emotion reactivity (anger r = .39; disgust r = .40; fear r = .38; sadness r = .29). Additionally, intellectual humility was identified as a theoretical variable of interest for its potential to buffer anger reactivity (r = -.23 in the present study).

Thus, an exploratory post-hoc analysis was conducted to determine the effect of training assignment on emotion after controlling for trait measures in ARGI emotion regulation and intellectual humility. More specifically, I included the Feedback subscale of the ARGI and the Intellectual Humility scale (see Appendix II for scale items). These variables are highly relevant to the goals of mindfulness practice particularly within anger-provoking or political contexts. First, anger *feedback* is defined by qualities of emotional clarity and equanimity, and is considered to be a prosocial and emotionally adaptive response to anger provocation. Second, intellectual humility describes the degree to which one feels personally threatened by ideological disagreements, which may bias psychological interpretation of partisan political content. I conducted a post-hoc MLM in which anger feedback and intellectual humility were additionally entered as first-level predictors. Analyses showed a significant main effect of pre-training anger (b = 1.109, $p <$ .001, 95% CI = .657 - 1.561) and anger feedback (b = 18.459, $p <$ .001, 95% CI = 9.617 - 27.301) on post-training anger, indicating that at the individual participant level, baseline anger feedback and anger reactivity to political videos significantly predicted anger reactivity scores following training. There was no main effect of training assignment ((b = -1.503, p = .700, 95% CI = 9.291 - 6.286) or intellectual humility (b = -7.857, p = .2601, 95% CI = -21.703 - 5.988) on post-training anger. However, there was a significant interaction of training assignment and pre-training anger on post-training anger (b = -.645, p = .045, 95% CI = -25.942 - 21.276), such the mindfulness group exhibited greater reductions in anger reactivity relative to the control group (Figure 8).

Subsequent analyses on post-training disgust, fear, joy, and sadness did not reveal a main effect of training group or interaction between training group and pre-training emotion (p's > .05). However, analyses did indicate a main effect of anger feedback on post-training disgust (b

= 12.349, p = .005, 95% CI = .388 - 20.817). Moreover, analyses demonstrated a main effect of pre-training emotion scores on post-training emotion in regards to disgust (b = .759, p = .002, 95% CI = .302 - 1.260), fear (b = .957, p < .001, 95% CI = .641 - 1.273), joy (b = .381, p = .035, 95% CI = .029 - .734), and sadness (b = .859, p < .001, 95% CI = .489 - 1.230).

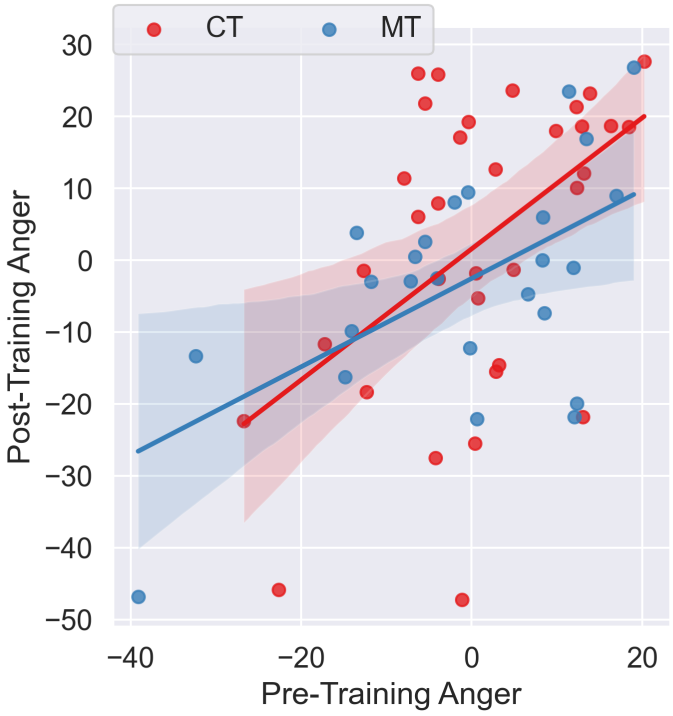

Figure 8. Interaction of pre-training anger reactivity scores and training assignment on post-training anger reactivity.

The Impact of Training on Explicit Intergroup Attitudes

MLM analyses were conducted to determine the impact of mindfulness *versus* active coping training on metrics of explicit intergroup attitudes, namely affective prejudice, social distancing, and intention to engage with a political outgroup member in conversation (i.e., behavioral intention) (see Table 4). Analyses did not indicate a main effect of training assignment on affective prejudice (b = -2.320, p = .649, 95% CI = -12.486 - 7.846), social distancing (b = -1.26, p = .853, 95% CI = -14.854 - 12.325), or behavioral intention (b = -.062, p

= .891, 95% CI = -.972 - .847). Post-hoc analyses were performed controlling for trait intellectual humility and ARGI anger feedback. While analyses did not indicate a main effect of training assignment, there was a significant main effect of intellectual humility on behavioral intention (b = 1.729, p = .036, 95% CI = .115 - 3.343), suggesting that intellectual humility increased willingness to speak to a Republican/conservative voter about political topics.

Table 4. Political Outgroup Attitudes

	Malleability Beliefs		Behavioral Intention		Affective Prejudice		Social Distance*	
	CT	**MT**	**CT**	**MT**	**CT**	**MT**	**CT**	**MT**
Mean	3.91	3.96	-1.62	-1.68	30.00	27.68	44.38	51.00
Std. Deviation	1.27	1.48	1.86	1.52	19.54	18.89	27.88	30.78
Minimum	1.25	1.00	-4.00	-4.00	0.00	0.00	0.00	0.00
Maximum	7.00	7.00	3.00	1.00	81.00	75.00	90.00	100.00

Note. *Social Distance scores are reverse coded such that higher scores reflect less desire for social distance from political outgroup members*.

The Impact of Training on Neural Representations of Political Content

Intersubject Correlation (ISC)

Significant channels identified within- and between-groups are summarized in Table 5 and Figure 9. Initial similarity analyses detected within-group neural synchrony within 25-95% of analyzed channels. Between-group ISC analyses revealed significant differences in neural time courses between the two groups, localized to channels 1 (ISC = .049, p = .045), 11 (ISC = .138, p = .040), and 15 (ISC = .091, p = .045) which correspond to the left middle frontal gyrus, left superior medial gyrus, and right superior medial gyrus respectively.

Table 5.

	Control	Mindfulness	Mindfulness ≠ Control
Channels exhibiting significant synchrony	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	5, 13, 14, 16, 18	1, 11, 15

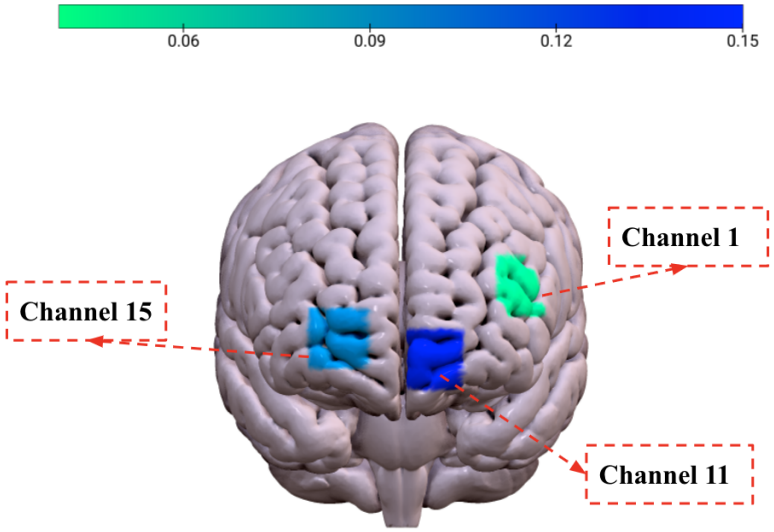

Figure 9. Results of subject wise permutation suggest greater synchrony (ISC) differences between groups within channels 1, 11, and 15.

Representational Similarity Analysis (RSA)

A series of RSA's were computed to further interpret the role of channel-specific neural synchrony underpinning mental representations of social-emotional content. After

behavioral similarity matrices were constructed for each variable of interest, an independent sample t-test was performed to determine the optimal similarity matrix structure. The results of nonparametric hypothesis tests are presented in Tables 6 and 7 and Figures 10 and 11.. Findings suggest the involvement of frontopolar (channel 4), dorsomedial (channels 10 and 15) and dorsolateral PFC regions (channels 3 and 17) in emotional and social representation.

Table 6.

	Anger	**Disgust**	**Fear**	**Joy**	**Sadness**
Similarity Model	AnnaK	AnnaK	NN	NN	AnnaK
Channels exhibiting representational overlap	2*	3, 4	17*	3	17

Note. Channel numbers exhibiting significant brain-behavior similarity structure as determined by RSA; * indicates marginal significance (p = .05)

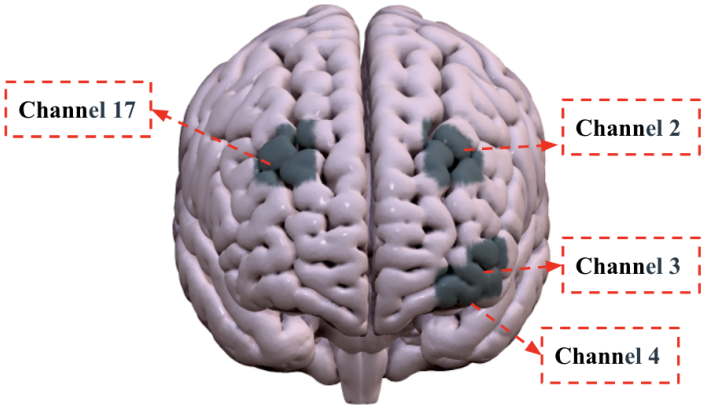

Figure 10. RSA results transposed in 3D cortical space. Shaded regions indicate channels showing brain-behavior similarity across ratings of anger (channel 2), disgust (channels 3 and 4), fear (channel 17), joy (channel 4), and sadness (channel 17).

Table 7.

	Affective Prejudice	**Social Distance**	**Behavioral Intention**	**Intellectual Humility**	**Anger Feedback**
Similarity Model	AnnaK	AnnaK	NN	AnnaK	AnnaK
Channels exhibiting representational overlap	15	3	3, 10*	--	3, 4

Note. Channel numbers exhibiting significant brain-behavior similarity structure as determined by RSA; * indicates marginal significance (p = .05)

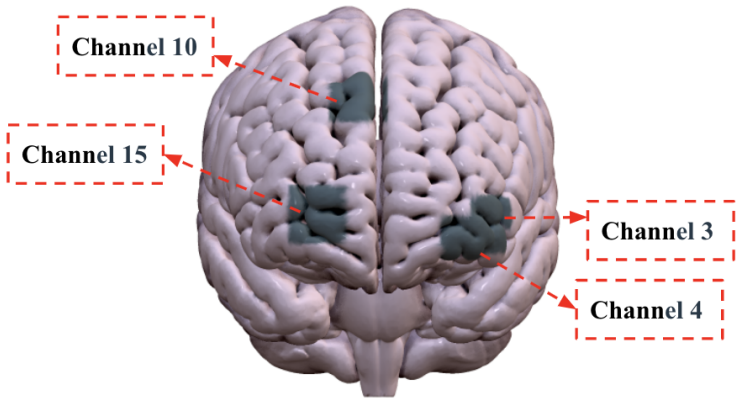

Figure 11. RSA results transposed in 3D cortical space. Shaded regions indicate channels showing brain-behavior similarity across measures of affective prejudice (channel 15), social distance (channel 3), behavioral intention (channels 3 and 10), and anger feedback (channels 3 and 4).

Discussion

Political polarization has become endemic to American society, and is a prevailing source of personal distress (Ford & Feinberg, 2020) and interpersonal conflict (Kalmoe & Mason,

2019). Heightened negative intergroup emotions further reinforce this partisan divide by motivating social distance, thereby forfeiting opportunities for cross-party compromise (Finkel et al., 2020). Intergroup emotion theory posits that intergroup conflict may be attenuated by regulating affective responses to political intergroup stimuli (Halperin et al., 2011); however, efforts to down-regulate emotions may be thwarted by a number of factors, including identity defensiveness, automated biases, and motivated cognition. Although under-researched in the political domain, mindfulness training is theoretically positioned to address such obstacles.

The present study aimed to determine if brief mindfulness training, relative to active coping training, could impact political intergroup emotions and attitudes by targeting moment-to-moment neural representations of politically salient news footage. Leveraging cutting-edge naturalistic viewing approaches, this multi-method RCT explored present-moment emotion reactions in conjunction with fNIRS time-locked neural dynamics. By extension, I investigated the potential downstream effects of mindfulness training on partisan attitude biases towards outgroup members. Bearing in mind systems meta-theory of emotions (Pilskin & Halperin, 2021), this study likewise attempted to account for personal-level factors (i.e., the motivation and tendency to regulate emotions, intellectual humility) implicated in adaptive responding to complex social-emotional scenarios.

Training Effects on Emotion Reactivity to Political Video Stimuli

Participants in both training conditions reported less negatively valenced emotion (i.e., anger, disgust, fear, and sadness) and greater positively valenced emotion (i.e., joy) after training. Relative to the active coping group, the mindfulness group exhibited greater changes in anger, disgust, fear, and joy, although such changes did not meet the threshold of statistical significance. Post-hoc MLM analyses were conducted to control for the feedback subscale of the

Anger-related Reactions and Goals Inventory (ARGI) and the Intellectual Humility scale, given their relevance to emotion regulation outcomes in anger-provoking political contexts. This approach yielded a significant interaction effect, indicating that relative to those assigned to active coping, mindfulness trainees exhibited greater attenuation of anger reactivity. This effect corresponds with multiple lines of research on emotion regulation intervention for affective polarization.

Mindfulness training and active coping training target distinct emotion regulation skills, with the former featuring attention control and acceptance and the latter relying on reappraisal and other problem solving strategies. Nevertheless, these skill sets cannot be entirely disambiguated. Mechanistic theories suggest that by fostering metacognitive skills, mindfulness may likewise enable reappraisal (Garland et al., 2009) and that mindfulness and reappraisal skills may reciprocally enhance one another (Garland et al., 2011). Notably, experimental and correlational research has linked both mindfulness and cognitive reappraisal to the management of negative intergroup emotion (Alkoby et al., 2017; Ford et al., 2019). The present study similarly indicates that both MT and CT reduced negative emotion reactivity following training; however, without a passive control comparison such outcomes cannot be presumed to arise from training. The mechanistic pathways of MT and CT are further complicated by personal and social goals motivating emotion regulation (Leach & Bou Zeineddine, 2021). While evidence suggests the positive influence of mindfulness and reappraisal on support for conciliatory policies (Halperin et al., 2013; Alkoby et al., 2017), another line of research suggests that attenuation of negative emotion via reappraisal may consequently lessen cross-partisan interaction (Ford et al., 2019; Ford & Feinberg, 2020). Such mechanistic discrepancies may be clarified by accounting for variables such as intellectual humility and anger feedback.

Defined as low ego defensiveness in regards to ideological disagreements (Krumrei-Mancuso & Newman, 2020), intellectual humility may influence the relationship between emotion regulation skills and their effective implementation, either by lowering the threshold of perceived self-threat or indirectly mitigating emotion reactivity. The use of anger feedback, which has been touted for its constructive nature or prosocial orientation (Kubiak et al., 2011), may similarly add a layer of complexity to emotion regulation systems. While the present study observed a strong positive effect of anger feedback on post-training anger reactivity, it cannot be determined whether or not anger feedback was adaptive to the context or individual. This point may be clarified by recent research emphasizing the importance of situation-strategy fit (Wenzel et al., 2020) such that providing feedback may only be beneficial under controllable circumstances and may instead backfire when implemented by low-status individuals (Pfeiler et al., 2017; Petkanopoulou et al., 2019). Such examples further underscore the principles of systems meta-theory, which caution against dimension reduction in favor of multi-leveled and complex models of emotion phenomena.

Training Effects on Explicit Intergroup Attitudes

In regards to promoting more benign intergroup attitudes, mindfulness training did not exhibit a significant advantage over active coping training. This finding runs counter to results featured in recent meta-analysis indicating a large effect of trait mindfulness and mindfulness-based interventions for the reduction of intergroup bias (Chang et al., 2022). However, the outgroup targets considered for this meta-analysis are marginalized populations (i.e., racial/ethnic minorities, the mentally ill, and LGBTQ+). In contrast, American liberal voters may view prejudice against opposing partisans as socially acceptable, or even morally justifiable (Kalmoe & Mason, 2019). Within the British electorate, a recent controlled trial showed

significant reductions in affective polarization as an outcome of mindfulness training relative to waitlist control (Simonsson et al., 2022). Notably, Simonsson et al. (2022) use an eight week mindfulness course adapted from Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1990) compared to waitlist control. The present study by contrast included a brief (14-day) program matched against a structurally-equivalent active control. Thus, it is plausible that the effectiveness of mindfulness may become apparent given larger doses (but see Strohmaier, 2020) or compared against a passive control.

Interpretation of the present findings is limited given that metrics of intergroup attitudes were administered solely at post-training, so analyses could not control for pre-training attitudes. The present study forwent repeated measures of these attitudes in order to conceal the objective of the study, i.e., to determine the effects of training on political intergroup emotions and attitudes. While this approach may reduce bias associated with demand characteristics (e.g., Berry et al., 2020), it bears the limitation of obscuring sources of within-person variability.

Intersubject Correlation (ISC) and Representational Similarity Analysis (IS-RSA) of Training Condition Differences

The following discussion, which aims to interpret neural synchrony findings, must be considered in light of null behavioral results. Research has previously noted the gap between *emotion experience* (as instantiated in the brain) and *emotion expression* (as self-reported) (e.g., Sasse et al., 2021), and subjective measures may be ill-equipped to capture the most salient dimensions of nuanced emotional experiences (Adolphs et al., 2016). Given that model-free techniques, such as ISC and IS-RSA, are poised to overcome such challenges using an exploratory approach, the proceeding discussion may serve to guide future hypothesis-driven research.

ISC analysis revealed significant group differences in neural synchrony when viewing partisan videos such that within-group ISC exceeded between-group ISC within channels 1 and 11, or within the left dorsolateral prefrontal cortex (dlPFC) and left ventromedial prefrontal cortex (vmPFC) respectively. Marginally significant neural synchrony differences between conditions were found within channel 15, likewise located within the dmPFC. Comparison of within-group ISC medians suggested that neural synchrony across all three regions was attributed to the active coping control group. While such an interpretation is consistent with 'bottom-up' mechanistic theories of mindful social-emotional regulation, further research is needed to corroborate such an account.

Neural synchrony within dmPFC and dlPFC regions, associated with the mentalization network, ostensibly represents shared interpretations of social emotional stimuli (Lahnakoski et al., 2014). Moreover, recent research suggests that synchrony within the dmPFC and dlPFC may be particularly relevant for the representation of negative emotion experience (Li et al., 2021) and intergroup hostility (Yang et al., 2020), respectively. While preliminary, these findings suggest that mindfulness may de-automatize top-down associations implicated in negatively biased intergroup perceptions. This claim is somewhat supported by the RSA results to be discussed here, suggesting that channel 15 synchrony predicted similarities in affective polarization. This is to say that channel 15 synchrony, which was greater within the CT group, may likewise drive affective polarization processes.

RSA results also suggested the role of vlPFC synchrony in intergroup emotion. Localized to channel 3, vlPFC synchrony was associated with similarities in disgust reactivity, joy, social distance, behavioral intention, and anger feedback. While the mechanisms underlying these processes may at first appear disparate, research suggests that the vlPFC may play a pivotal role

in social decision-making (Nelson & Guyer, 2011). By integrating emotional information irrespective of valence, the vlPFC is thought to facilitate flexible approach/avoidance behavior and management of social rule information (Donahue et al., 2008). In accord with this functional account, the present study observed broad involvement of the vlPFC in representing socially-relevant emotions. Although neural synchrony research has predominantly focused on mechanisms of dmPFC synchrony—and to a lesser extent, dlPFC synchrony—the role of the vlPFC may warrant greater attention from social affective neuroscientists.

Limitations and Future Directions

The present study was exploratory in nature with little precedent for hypothesis testing or sample size estimation. Thus, conclusions drawn from this study are limited by a small sample size. A sample size of 70 participants was determined based on power estimations from prior fNIRS research indicating that sample sizes of 60-75 participants were powered to detect between-group effects in neural synchrony. Data collection was limited by time constraints attributable to the restrictions placed on research following the onset of the COVID-19 pandemic. Given that the time frame for data collection was significantly abbreviated, analyses were conducted using the data of 60 participants. The analyses revealed trends suggesting the considerable influence of within-person variability; however, sample sizes under 70 are likely underpowered to detect such effects.

The present study was limited to Democratic-voting, liberal-leaning participants, thus limiting generalizability. The rationale for this decision is founded primarily in logistical concerns. A critical assumption of neural synchrony approaches is that participants are exposed to the same time-locked stimuli (Nastase et al., 2019) in order to accurately capture stimulus-driven brain activity. Thus, it was imperative to select video stimuli that would reliably elicit

intergroup emotions across all participants, which may be done most reliably by controlling for partisan identity. Interestingly, some evidence argues in favor of a 'symmetry model' of partisanship, in which Democratic and Republican partisans are equally susceptible to the cognitive-affective biases described within this paper (Ditto et al., 2019). Alternatively, other research adopts an 'asymmetrical' stance by suggesting that partisan alignment may be associated with preference for certain cognitive strategies over others (e.g., intuition, abstract reasoning, etc.) (Baron & Jost, 2019). Replication of the present research in conservative leaning/Republican-voting sample may potentially elucidate such distinctions.

On a related note, the present sample is characterized by an overrepresentation of white cis-women. The overrepresentation of WEIRD populations–those of Western, educated, rich, and educated backgrounds–is a pervasive issue within social neuroscience research (Burns et al., 2019). Moreover, meta-analytic evidence shows that mindfulness RCT samples predominantly feature white cis-women (Eichel et al., 2021). The present study is no exception to these trends, and their potential impact warrants thoughtful consideration. Intersectional identities are inextricably linked to perceptions of political events, especially since highly contentious political topics often concern the wellbeing of marginalized peoples. While this poses considerable challenges to generalizability (see commentary by Harris et al., 2021), it also underscores the importance of modeling unique features of context, including characteristics of social identity (Pilskin & Halperin, 2021).

Social emotions are rich, multidimensional phenomena (Adolphs et al., 2016; Leach & Bou Zeineddine, 2021). Political intergroup emotions are not exempt from this rule. Such complexity may be further parsed out by modeling changes in neural synchrony from pre- to post-intervention via linear mixed effects modeling, which has recently been recommended as an

efficient and robust platform for analyzing ICA data (Chen et al., 2017). In addition to modeling within-participant variability, such an approach may also capture training-driven plasticity in neural synchrony, which can only be inferred indirectly in the present report. Similarly, disaggregating emotion reactivity scores, thereby applying a repeated-measure approach, may elucidate the dynamic qualities of emotion regulation.

Conclusion

The present study is among the first to investigate the impact of mindfulness training on political intergroup emotions as a means to reduce affective polarization. Consistent with theories of mindful de-automatization, the findings provide preliminary evidence that mindfulness training may disrupt anger reactivity to partisan content via disruptions to top-down processing. This line of research is only beginning however, and considerable research is needed to determine the optimal pathways to promote positive intergroup change.

Appendix I

FNIRS Channel Locations

Channel	**S-D Pair**	**Nearest MNI Coordinate**		
		x	*y*	*z*
1	1-1	-49	46	20
2	1-2	-32	48	39
3	2-1	-48	54	-3
4	2-3	-36	65	-12
5	3-1	-43	57	11
6	3-3	-26	70	1

7	3-4	-15	69	19
8	4-2	-11	50	49
9	4-4	2	58	38
10	4-5	10	51	49
11	5-3	-13	72	-8
12	5-4	1	68	9
13	5-6	14	72	-7
14	6-4	15	69	19
15	6-6	26	70	1
16	6-7	43	58	12
17	7-5	32	49	38
18	7-7	48	47	20
19	8-6	36	65	-11
20	8-7	49	54	-3

Appendix II.

Anger-related Reaction and Goals Inventory - Feedback Subscale (Kubiak et al., 2011)

1. I tell the other person what annoys me, but without being aggressive.
2. I tell the other person what I disagree with in a calm but clear way.
3. I speak to the other person openly about what makes me feel angry.
4. I try to remain objective but firm.

Intellectual Humility Scale (adapted for political ideologies; Krumrei-Mancuso & Newman, 2020)

1. I feel small when others disagree with me on topics that are close to my heart. (R)
2. When someone contradicts my most important beliefs, it feels like a personal attack. (R)
3. When someone disagrees with ideas that are important to me, it feels as though I'm being attacked. (R)
4. I tend to feel threatened when others disagree with me on topics that are close to my heart. (R)
5. When someone disagrees with ideas that are important to me, it makes me feel insignificant. (R)
6. I am open to revising my important beliefs in the face of new information.
7. I am willing to change my position on an important issue in the face of good reasons.
8. I am willing to change my opinions on the basis of compelling reason.
9. I have at times changed opinions that were important to me, when someone showed me I was wrong.
10. I am willing to change my mind once it's made up about an important topic.
11. I can respect others, even if I disagree with them in important ways.
12. I can have great respect for someone, even when we don't see eye-to-eye on important topics.
13. Even when I disagree with others, I can recognize that they have sound points.
14. I am willing to hear others out, even if I disagree with them.
15. I welcome different ways of thinking about important topics.
16. I respect that there are ways of making important decisions that are different from the way I make decisions.
17. My ideas are usually better than other peoples' ideas. (R)
18. For the most part, others have more to learn from me than I have to learn from them. (R)
19. When I am really confident in a belief, there is very little chance that belief is wrong. (R)
20. On important topics, I am not likely to be swayed by the viewpoint of others. (R)
21. I'd rather rely on my own knowledge about most topics than turn to others for expertise. (R)
22. Listening to the perspectives of others seldom changes my important opinions. (R)

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Supplemental Materials

Table S1. Trait Measure Descriptive Statistics

	Group	Mean	SD	SE	*p*
Anger Feedback	CT	2.65	0.58	0.10	> .05
	MT	2.39	0.72	0.14	
Trait Mindfulness	CT	3.22	0.77	0.13	> .05
	MT	3.30	0.97	0.19	
Intellectual Humility	CT	3.60	0.36	0.06	> .05
	MT	3.52	0.33	0.07	

Table S2. Emotion Regulation Trait Measure Descriptive Statistics

	Group	Mean	SD	SE	*p*
Beliefs about emotions	CT	4.05	0.96	0.17	> .05
	MT	4.08	1.08	0.21	
Affective Style - Concealing	CT	42.18	5.98	1.03	> .05
	MT	42.58	6.03	1.18	
Affective Style - Adjusting	CT	19.79	4.46	0.76	> .05

	MT	19.42	5.60	1.10	
Affective Style - Tolerating	CT	15.76	3.39	0.58	> .05
	MT	14.81	2.95	0.58	
Emotion Regulation Goals - Prohedonic	CT	4.85	0.95	0.16	> .05
	MT	4.72	1.17	0.23	
Emotion Regulation Goals - Contrahedonic	CT	2.05	0.91	0.16	> .05
	MT	1.76	0.83	0.16	
Emotion Regulation Goals - Performance	CT	5.36	0.73	0.13	> .05
	MT	5.09	1.14	0.22	
Emotion Regulation Goals - Prosocial	CT	5.02	0.87	0.15	> .05
	MT	5.22	1.07	0.21	
Emotion Regulation Goals Impression Management	CT	4.94	1.21	0.21	> .05
	MT	4.50	1.51	0.30	
Anger Reactivity - Vent	CT	1.79	0.56	0.10	> .05
	MT	1.70	0.53	0.10	
Anger Reactivity - Rumination	CT	3.03	0.68	0.12	> .05
	MT	2.96	0.85	0.17	

Anger Reactivity - Downplaying	CT	2.49	0.57	0.10	> .05
	MT	2.42	0.65	0.13	
Anger Reactivity - Distracting	CT	2.54	0.59	0.10	> .05
	MT	2.63	0.79	0.15	
Anger Reactivity - Submission	CT	2.10	0.89	0.15	> .05
	MT	2.27	0.96	0.19	
Anger Reactivity - Humor	CT	1.65	0.75	0.13	> .05
	MT	1.63	0.69	0.13	
Anger Reactivity - Personal Standards	CT	2.60	0.67	0.12	> .05
	MT	2.45	0.77	0.15	
Anger-Related Goals - Social Norms	CT	2.78	0.76	0.13	> .05
	MT	2.65	0.69	0.14	
Anger-Related Goals - Protect Reputation.total	CT	2.71	0.71	0.12	> .05
	MT	2.57	0.87	0.17	
Anger-Related Goals - Weigh Costs	CT	3.07	0.68	0.12	> .05
	MT	3.09	0.72	0.14	
Anger-Related Goals - Regulate Affect	CT	3.54	0.55	0.09	> .05

	MT	3.43	0.51	0.10	
Anger-Related Goals - Revenge	CT	1.62	0.61	0.11	> .05
	MT	1.51	0.48	0.09	

Table S3. Emotion Reactivity to Control Stimuli

	Pre-training Anger		Post-training Anger	
	CT	**MT**	**CT**	**MT**
Mean	26.68	20.58	14.02	15.17
Std. Deviation	14.17	12.60	9.72	10.69
Minimum	6.55	7.65	1.00	1.00
Maximum	54.61	46.78	37.67	47.00

	Pre-training Disgust		Post-training Disgust	
	CT	**MT**	**CT**	**MT**
Mean	27.26	21.74	14.34	13.83
Std. Deviation	14.77	13.87	13.96	9.88
Minimum	3.45	1.73	1.00	1.32
Maximum	60.48	47.66	50.29	38.38

	Pre-training Fear		Post-training Fear	
	CT	**MT**	**CT**	**MT**
Mean	20.35	17.85	14.38	12.50
Std. Deviation	12.89	13.06	12.78	8.78
Minimum	1.00	2.51	1.00	1.00
Maximum	47.18	48.67	51.65	28.43

	Pre-training Sadness	Post-training Sadness

	CT	MT	CT	MT
Mean	26.07	21.33	15.21	17.60
Std. Deviation	13.91	14.58	12.56	12.00
Minimum	3.04	1.30	1.00	3.43
Maximum	50.06	46.31	49.13	41.79