

RACIAL DISCRIMINATION AND MENTAL HEALTH: TEMPORAL DYNAMICS
AND NEUROCOGNITIVE MODERATORS

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AND NEUROCOGNITIVE MODERATORS

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ABSTRACT

Experiencing racial discrimination is related to both mental and physical health (Mays et al., 2007; Pascoe & Richman, 2009; Schmitt et al., 2014). However, much of this research focuses on population-level relationships using cross-sectional samples and questionnaires, which is unable to examine temporal relationships between the experience of racial discrimination and mental health outcomes. The current study examined the effect of racial discrimination experience by Black college students at the University of Missouri using Ecological Momentary Assessment. A complex temporal relationship between reported discrimination and affect, depression, and anxiety emerged, such that reports of discrimination had an immediate negative effect, resulting in higher levels of negative affect, depression, and anxiety. However, this negative effect did not persist and instead resulted in an increase in positive affect several hours after the report. Additionally, neurocognitive indices of attention to threat neither corresponded as expected to frequency of reports of discrimination, nor moderated the effect of discrimination as expected.

INTRODUCTION

Overview

Decades of research have documented the psychological toll associated with experiences of racial discrimination (e.g., Clark et al., 1999; Williams et al., 2003). These experiences include major life events (e.g., getting fired from a job or being detained or abused by the police; Williams et al., 1997), as well as less severe but more often occurring experiences (e.g., receiving poorer service at restaurants, being stared at or harassed, or being called names or insulted; Essed, 1991; Sue et al., 2007). Meta-analyses have shown a positive relationship between discrimination and psychological distress among members of minority groups (Pascoe & Richman, 2009; Schmitt et al., 2014), including African Americans (Pieterse et al., 2012). Other research has shown positive associations between frequency of discrimination and severity of clinical outcomes, including Generalized Anxiety Disorder (Soto et al., 2011) and Major Depressive Disorder (Chou et al., 2012), as well as physical health outcomes, including cardiovascular disease and mortality rates (Mays et al., 2007). These negative outcomes are hypothesized to be the result of chronic stress or allostatic load imposed by subtle but often occurring race-related incidents that contribute to racial disparities in health across a broad spectrum of health outcomes (Mays et al., 2007).

Much of the existing work on racial discrimination and mental health has focused on population-level relationships, using cross-sectional samples and questionnaires (e.g., Williams et al., 1997). While informative, such work does not allow researchers to establish the temporal association between discrimination and daily mental health outcomes. This limitation dramatically reduces the ability of researchers to draw causal

inferences concerning the influence of discrimination on mental health, which have often been assumed but not tested (Lilienfeld, 2017). The current project extends existing research by using ecological momentary assessment (EMA; see Table 1 for all acronyms), in which participants use a smartphone application to repeatedly report discrimination, affect, and anxiety/depression symptoms during daily life over the course of several weeks. This methodology allows for the assessment of temporal dynamics in the within-subjects relationship between racial discrimination and psychological distress among African American college students.

Additionally, although much research has been dedicated to the investigation of socio-cultural individual differences that buffer the effect of discrimination on mental health, such as ethnic/racial identity, social support, and anger expression (Brondolo et al., 2009), research is limited on individual differences in neurocognitive processes that may function as vulnerability factors for individuals from minority groups. Investigation of such neurocognitive factors can be useful for identifying treatment targets for vulnerable individuals. The current project uses event-related potentials (ERPs) to index neurocognitive processes related to attention to threat, which has been associated with the development and maintenance of anxiety disorders (Cisler & Koster, 2010). Through a combined EMA and ERP approach, this research integrates reliable measures of individual differences with repeated measurements of discrimination and psychological distress, extending our understanding of the health consequences of discrimination experienced by African Americans.

Temporal Dynamics in the Relationship Between Racial Discrimination and Mental Health

The most prominent and influential model of the relationship between racial discrimination and health is the biopsychosocial model (Clark et al., 1999), which posits that repeated experiences of racial discrimination, both actual and perceived, contribute to the accumulation of stress and allostatic load and increases wear and tear on the body and mind over time (Mays et al., 2007). This conceptualization of racial discrimination as a physical and mental stressor is corroborated by experimental studies showing that experiencing or witnessing an interaction construed as discriminatory or racist results in an acute physiological stress response, raising blood pressure and heart rate, increasing sympathetic nervous system activity, decreasing parasympathetic nervous system activity, and increasing cortisol (e.g., Brondolo et al., 2003; Cooper et al., 2014; Huynh et al., 2017; Lockwood et al., 2018; Neblett & Roberts, 2013; Sawyer et al., 2012; Volpe et al., 2019). Given the link between stress, heightened cardiovascular reactivity, and the development of cardiovascular disease and risk (e.g., Lovallo & Gerin, 2003; McEwen & Stellar, 1993; Treiber et al., 2003), conceptualizing discrimination as an acute and chronic stressor suggests a physiological mechanism for the link between discrimination and negative physical health outcomes. Similar research has examined the acute effect of lab-based discrimination on mental health, including anxiety, depression, and affect (e.g., Bennett et al., 2004; Hoggard et al., 2017; Masten et al., 2010), finding similarly negative causal effects of experimentally-induced discrimination on mental health.

However, the opposite causal relationship is possible, such that elevated negative affect or anxiety may lead to the interpretation of an ambiguous interaction as race-

related and discriminatory (Lilienfeld, 2017; Phinney et al., 1998), maintaining and perpetuating negative mental health. Outside of the context of discrimination, research suggests that high-anxiety individuals are more likely to classify emotionally ambiguous faces as fearful (Richards et al., 2002), and ambiguous events as threatening (Constans et al., 1999). Similar biasing influences on the perception of ambiguous stimuli have been shown in participants with depression (Everaert et al., 2017; Hindash & Amir, 2012). Thus, it is possible that individuals from minority groups that are high in anxiety or depression are more likely to construe ambiguous interactions or situations as discriminatory, which may contribute to continued negative mental health. However, previous research has specifically identified consistency, distinctiveness, and consensus as important elements when making appraisals about whether something is discriminatory, and that people from minority groups often minimize their experiences with discrimination (McClelland et al., 2016). Thus, although high anxiety or depression may influence participants to perceive ambiguous experiences as more negative, I hypothesize that this influence will not affect a participant's construal of the event as discriminatory.

The current research tests both possibilities by examining temporal precedence, hypothesizing that experiences of discrimination will precede psychological distress, consistent with the claim that discrimination acts as a stressor that has consequences for mental health. This would be consistent with previous longitudinal research that reports a correspondence between increases in discrimination and increases in depression over the course of several years (Brody et al., 2006; Schulz et al., 2006). However, longitudinal studies are limited by their reliance on retrospective self-report of discrimination, which

introduces well-documented recall biases (Fahrenberg et al., 2007) and have reduced sensitivity to less salient or mundane patterns of discrimination that are often shrugged off or forgotten over time (Swim et al., 2003). Daily diary studies reduce such recall biases (Ebner-Priemer & Trull, 2009) and have additionally reported a spillover effect of discrimination on negative affect the following day, suggesting negative affect increases as a result of discrimination (Burrow & Ong, 2010; Ong et al., 2009). However, because discrimination and mood were reported at the same measurement occasion at the end of each day, these studies were unable to eliminate the possibility that same-day negative affect preceded the experience of discrimination on that day.

Thus, in the current study, I test differences in negative affect, depression, and anxiety at the time of a reported instance of discrimination, following the event and preceding the event. An EMA approach allows for this by capturing experiences of discrimination and participants' emotional reactions in near real-time and by increasing the frequency with which participants report their levels of psychological distress and mood. After any race-related incident (i.e., interpersonal experience where participants thought they would have been treated differently if they had been of another race), participants initiated a report to describe the event and report current psychological distress (*event-based* sampling). Participants were additionally randomly prompted throughout the day to report their current psychological distress and mood (*random* sampling). A combination of event-based and random sampling permits examination of temporal precedence in the relationship between discrimination and general psychological distress, thereby allowing tests of the following hypotheses:

Hypothesis 1A: Experiences of racial discrimination will result in an acute increase in psychological distress, anxiety, and depression, measured on the same prompt as the reported event.

Hypothesis 1B: The delayed negative effect of racial discrimination will spill over and be evident on the following prompt and the following day.

Hypothesis 1C: Increased anxiety or depression (either state or trait) will not increase the likelihood of perceiving an interaction as discriminatory.

Attention to Threat and the Experience of Anxiety

In addition to examining temporal dynamics in the experience of racial discrimination and mental health, I examined the role of individual differences in vigilance, or biased attention to threat, in the experience of anxiety related to race-related discrimination. Biased attention to threat has been demonstrated in all anxiety disorders, including generalized anxiety disorder, post-traumatic stress disorder, obsessive-compulsive disorder, social phobia, and panic disorder, and likely reflects elevated general trait anxiety (Bishop, 2007; Cisler & Koster, 2010). Much of the research dedicated to this topic has used a groups-based approach, with a large meta-analysis finding a robust bias in attention toward threatening stimuli among anxious individuals ($d = 0.45$) but not non-anxious individuals ($d = -0.01$; Bar-Haim et al., 2007). Additional cross-sectional, longitudinal, and experimental evidence suggests that individual differences in biased attention to threat may function as a vulnerability factor in the development of anxiety disorders (Pérez-Edgar et al., 2010, 2011; Van Bockstaele et al., 2014). Given that experiences of racial discrimination are associated with increased anxiety (Levine et al., 2014; Soto et al., 2011), it stands to reason that biased attention to

threat may be involved in this relationship. The current research tested two possibilities in which biased attention to threat may function as a vulnerability factor for experiencing anxiety as a result of discrimination: 1) That individuals with high attention to threat experience discrimination at the same rate as individuals with low attention to threat, but are more sensitive to its negative effects; and/or 2) That individuals with high attention to threat detect discrimination more readily, which increases anxiety.

To test these possibilities, I examined two psychophysiological indices of attention to threat. While self-reported vigilance has been previously examined as a moderating factor in the effects of discrimination (e.g., Himmelstein et al., 2015; LaVeist et al., 2014), such investigations are limited by individuals' awareness and ability to report cognitive mechanisms that may operate at a pre-conscious level, including vigilance or attention to threat. In this regard, lab-based investigations are useful in measuring attentional processes related to threat. In the lab, attention to threat has been measured using both response behavior and event-related potentials (ERPs) recorded during computerized cognitive tasks. However, ERP measures have considerably better internal and retest reliability (Gibb et al., 2016) than overt response behavior, have high temporal resolution, and permit covert measurement and identification of quickly occurring attention-related processes that are unobservable using behavioral methods alone (see Woodman, 2010). These attributes make ERPs a particularly useful measure of individual differences related to attention to threat. I examined two different ERP components elicited in different cognitive tasks to assess attention to race-specific forms of threat. Specifically, I examined 1) The N2pc ERP component elicited by angry and

neutral White and Black male faces in a dot-probe task; and 2) The P2 ERP component elicited by Black and White faces in a categorization task.

The N2pc ERP Component

The N2pc is a negative-going potential at posterior electrode sites contralateral to the location of an attended item (i.e., if a stimulus on the right side of a computer screen is attended to, the N2pc will be evident over the left hemisphere; see Luck, 2012). This negativity represents a lateral shift of spatially selective attention to an attended stimulus (Eimer, 1996; Mazza et al., 2009) and has been used in a number of different tasks to index covert orienting of attention to emotional faces. A number of researchers have found larger N2pcs to threatening stimuli compared to nonthreatening stimuli, including attacking dogs or guns (Kappenman et al., 2015) and angry or disgusted faces (Feldmann-Wüstefeld et al., 2011; Fox et al., 2008; Holmes et al., 2009). Additionally, N2pcs elicited by threatening images have been shown to be particularly pronounced for anxious individuals (Fox et al., 2008; Judah et al., 2016). In the current study, I examined the N2pc elicited by angry and neutral faces of different races in a dot-probe task to get separate indices of vigilance to threatening Black faces and threatening White faces. In the dot-probe task, participants viewed pairs of faces, one on the left and one on the right side of the screen. Pairs of faces were either both Black faces or both White faces, one with an angry expression and one with a neutral expression. When viewing both Black and White faces, I expected to see a larger N2pc contralateral to the side of the angry face, indicating a shift of covert attention towards the location of the angry face, as has been found in previous studies (Feldmann-Wüstefeld et al., 2011; Grimshaw et al., 2014; Holmes et al., 2009, 2014; Weymar et al., 2011). Additionally, attention may be more

biased towards angry compared to neutral faces when the faces were White rather than Black, especially for people who have experienced discrimination often, as Black people are more likely to be discriminated against by White people compared to other Black people. Thus, I created two indicators of attention to threat using N2pc amplitude: 1) Each individual's N2pc for angry faces relative to neutral faces, aggregated across all trials, as a general measure of attention to threatening faces; and 2) The difference between each individual's N2pc when viewing White angry/neutral pairs compared to their N2pc when viewing Black angry/neutral pairs, as a race-specific measure of attention to threatening faces. Using these measures, I tested the following hypotheses:

Hypothesis 2A: The general N2pc will be related to an individual's level of anxiety.

Hypothesis 2B: Enhanced N2pcs when viewing White relative to Black faces will be associated with reporting more discrimination events.

Hypothesis 2C: Enhanced N2pcs viewing White relative to Black faces will moderate the influence of discrimination on subsequent negative affect, anxiety, and/or depression, such that higher vigilance results in a more negative effect of discrimination.

The P2 ERP Component

In addition to the N2pc, I examined the P2 ERP component elicited by both Black and White faces. The P2 has been extensively researched in the context of race perception and is a positive deflection that occurs about 150-250 ms after the presentation of the face at central-parietal electrode sites (Ito & Senholzi, 2013). P2 amplitude is consistently larger following racial outgroup faces compared to racial ingroup faces

(Bartholow & Dickter, 2011), and has been associated with orienting of attention to threatening visual stimuli (Correll et al., 2006; Kubota & Ito, 2007). Differentiation in P2 amplitude according to race has previously been associated with White individuals' implicit racial bias (He et al., 2009) and associations between African-Americans and danger or threat (Correll et al., 2006), suggesting P2 amplitude provides an index of how threatening an individual perceives an outgroup member to be. However, differentiation in P2 amplitude to faces of different races has not yet been examined as a marker of individual differences in attention to threat in non-White participants. If larger P2s to racial outgroup faces compared to racial ingroup faces are functionally related to the degree to which the outgroup face is perceived as threatening, it stands to reason that Black participants who encounter discrimination from White people more frequently may perceive White faces as more threatening and thus exhibit larger P2s to White compared to Black faces. However, the P2 has no established link with anxiety or depression. Thus, I tested the following hypothesis but did not have any specific hypotheses regarding the link between P2 amplitude and affect, anxiety, or depression measured during the study:

Hypothesis 3: That differentiation in the P2 to White and Black faces will be related to both the number of discrimination events reported during the EMA period as well as self-reported discrimination encountered over the past year.

METHOD

Focus Groups

Before beginning EMA and ERP data collection, I conducted several focus groups with the purpose of developing a better understanding of the kinds of discrimination Black students at Mizzou face and how individuals respond to them in their own lives. Conducting these focus groups was an important part of engaging with a community-based participatory research (CBPR) framework, which seeks to integrate the goals of the researcher with the goals of the community involved in the research in a mutually beneficial and respectful way. The CBPR framework additionally seeks to incorporate community participation and local theories of etiology and change (Wallerstein & Duran, 2006; Wallerstein & Duran, 2010). Additionally, the integration of qualitative methods can enhance the substantive contribution of quantitative research through a deeper understanding of the phenomenon of interest and consideration of previously unconsidered issues.

Participants

Sixteen students who self-identified as Black/African-American (14 women, 2 men) and were currently enrolled undergraduate or graduate students at Mizzou participated in the focus groups. Four focus groups were conducted over the course of two weeks in the Fall of 2018, with four participants in each focus group. All participants chose pseudonyms to identify themselves, which are used in this reporting. Some quotes have been slightly edited for clarity.

Procedure

At the beginning of each focus group, I explained that the purpose of the group was to better understand the experiences of racial discrimination that students experience, and the consequences of those experiences. I went over some ground rules and expectations for participation before participants gave their informed consent. All focus groups were recorded using an audio recorder and were transcribed later. One or two Black undergraduate research assistants were present at each focus group and the first two groups included an additional facilitator besides myself. Each focus group was semi-structured and participants were encouraged to interact and react to each other throughout the conversation. To begin the conversation, I asked participants to introduce themselves using their pseudonym, tell the group a little about themselves, and describe how race has affected their experience as students at Mizzou in both positive and negative ways. Throughout each conversation, I or my co-facilitator asked follow-up questions that probed for more information about an experience or topic the participants described, or to open a new avenue of discussion. Additional questions included, “Are there certain situations or environments where you feel particularly on edge or vigilant?”, “How often do you experience an ambiguous interaction that may be the result of discrimination but you’re not sure?”, “How are your experiences at Mizzou different from where you grew up?” and “What kinds of coping styles do you use?”

Themes

There were several common themes or topics of conversation that emerged across focus groups. Participants described positive aspects of their Black identity, which has resulted in feelings of connection with Black student organizations and the Black

community at Mizzou. We also discussed negative experiences of discrimination that participants had experienced. Lastly, we discussed different coping strategies that participants use in response to these negative experiences.

Positive experiences. The types of positive experiences participants primarily described included the strong sense of community they felt with other Black students, which contributed to a feeling of belonging. Arianna said, “This is one thing that puts us all together, and I feel like I have a sense of community more so than other people have because it’s—I think adversity brings people together. It’s like, ‘you feel this way, I feel this way,’ we can automatically connect. I think that I have stronger, deeper relationships because of my race.” Other participants mentioned being the recipient of fellowships for minority students and how Black organizations reached out to make them feel welcome, both of which have had positive effects on their experience as students. Several participants additionally said that being a Black student at Mizzou has prepared them for the rest of the world, in that they have learned to deal with the types of negative experiences a Black person expects to experience. For example, Lisa reframed the negative aspects of experiencing microaggressions at work, saying, “This past summer I had an internship, and so I experienced a few microaggressions, being a black woman in the workplace but I was able to cope a little bit better, recognize what that was...A lot of things I don’t even waste time on anymore, because I—so I guess that’s positive too, because I can kind of spot that out in the beginning.” Kay agreed, saying, “I’m able to talk to people and be aware of what they might think or not let things that they say phase me and it doesn’t come as a shock to me when they say it, so I wouldn’t be like caught

off guard if somebody said something discriminatory or something. I just kind of brush it off and be like whatever, so I definitely think it's a positive for me."

Negative experiences. Although some participants mentioned positive aspects of being Black at Mizzou, many more negative experiences were described. Among the experiences described, I identified the following commonalities in the negative experiences described: 1) Being the only Black student in class; 2) Erasure of culture; 3) Experiencing microaggressions; 4) Experiencing or witnessing overt racism; and 5) Vicariously experiencing discrimination through fellow students or the media.

Being the only Black student in class or other spaces at Mizzou where students are required to be was described as both isolating, because it was hard to connect with White students, and stressful, because participants felt like they always had to be a good representative for their race. In describing her experience, Arianna said, "I think about how I interact with people every single day because I feel like I represent being Black. So if I'm in class, I wanna sit in the front and I wanna raise my hand because I feel like I have our race on our shoulders, and I don't think that other people have to deal with that. I think they just know that they represent themselves and not their entire community." These experiences were associated with a lot of pressure to be on their best behavior and that there were consequences for the rest of the Black community depending on how others evaluated them, which is both anxiety-provoking and stressful.

Several participants also discussed experiences where they felt their **culture was being erased or ignored**. Participants described experiencing this in history, women and gender studies, sociology, English, and education classes, among others. For example, Sarah said, "I have issues with this term 'western culture'—like one of my teachers uses

that heavy and compares it to different cultures and I'm like well—I feel like I'm a part of western culture and my culture isn't like that so I don't know. They talk about white culture, I guess, but call it western culture.” Sarah also talked about her history classes and how the perspective of Black folks throughout American history was completely ignored. It frustrated her so much that she wrote about it on her final and failed as a result, so she had to retake the class. This erasure contributed to feelings of being ignored, that the contributions of the Black community were not being valued, and that cultural aspects specific to the Black community were unimportant to White people. Lou described a Women's and Gender Studies class that only mentioned minority women as an aside whereas the majority of the class focused on issues relevant to White women, as well as an English class that only included White male authors on the syllabus, plus one selection from Toni Morrison. Erasure also included things like White students not understanding how race was relevant to a particular issue or discussion and accusing Black students of playing the race card, and not knowing about institutions, social cues, or other cultural elements important to Black communities, like the National Pan-Hellenic Council [organization of historically Black fraternities and sororities] or the NAACP. Given the lack of integration of Black culture and history into the mainstream, participants felt the onus was on Black students to have knowledge about both cultures and code-switch, depending on which situation they're in. Blake said, “[On campus,] there's no walls but you can still feel the space in between. It'll be like, you have to learn about two cultures. So it's like you have to learn about your own culture and the National Pan-Hellenic Council and stuff like that. But at the same time, you have to learn about white culture because that's how you're gonna make it. And it's annoying because you

notice that if you have some friends that aren't of color, they don't have to know your culture.”

Many participants additionally described instances of **microaggressions** where participants experience negative interactions or events that cannot easily be called out for being racist but communicate hostile, derogatory, or negative racial slights and insults toward people of color, sometimes without the awareness or intention of the perpetrator (Sue et al., 2007). Examples include a professor making assumptions about the person's financial background, being called ghetto, nobody wanting to partner in bio lab, getting bumped on sidewalks without the other person saying, “Excuse me,” being told to “take up less space” in class, not being promoted, despite previous norms of promotion happening at a certain experience level, and being treated as if a threat, which was especially the case for the male participants. These experiences were negative, uncomfortable, or anger-inducing, but could not clearly be called out as “racist” without the fear of backlash due to an inability to point to race as the specific cause. Participants reported experiencing these kinds of things in their day-to-day life but worried about making a fuss for fear of being labeled as a “trouble maker”. In some cases, because of the ambiguity of the situation, participants reported not always being sure if the action was discriminatory or whether there was some other reason for the negative interaction, thus spending extra time and emotional energy trying to make sense of the event. Arianna said, “So it's little things like that where as a minority woman, I don't know—is this discriminatory? Do I talk to someone about it? Who should I talk to about it? Or, am I just gonna like play the race card and make things worse for myself?” Kay said, “I feel like sometimes when stuff happens...then the first thing that comes to my mind is, ‘Okay,

so what was happening in there?’ But then sometimes I’ll be like, am I being rude to think that [was racist] or am I not justified in thinking like that, because that’s always the first thing that comes to my mind.” Emily similarly said, “I kind of evaluate the situation and say okay is this me bringing my own perception of like what I think people think of me into the situation or is this really what’s happening.” Depending on the person, this rumination can continue for days afterwards, which costs emotional energy and can contribute to self-doubt. Lou said, “I really hate that that’s a thing we have to deal with. It’s like, you know—other people don’t necessarily have to think about every interaction they have and what that could mean and whatever, and it just makes you really paranoid sometimes.”

In addition to microaggressions, several participants reported **overt experiences with racism**. Arianna described a very emotional experience as a freshman where she was in the car with several White friends. Another Black person was crossing the road in front of the car and the (White) driver said, “Hurry up” and then said the n-word with a hard ‘R’. Following that event, Arianna broke contact with those friends and became more involved with the Black community instead. Diana described her experience during the protests in Fall 2015 when several death threats were made on Yik Yak, an anonymous social media platform. As a result of those death threats, she was scared for her life and distrustful, which was disruptive to her academic performance and feelings of safety and trust with her White classmates. Several participants also mentioned overt hostility experienced in Greek town. Jazz said, “With a lot of sororities, fraternities, they might as well have ‘Whites only’ signs or ‘Blacks only’ signs up.” Diana agreed, saying,

“I feel prepared to be uncomfortable walking through Greektown at night now, because you don’t want us there, but our music is there.”

Lastly, in one focus group, we discussed the effects of **vicariously experiencing racism**, including watching videos of police brutality, reading news articles, or hearing about negative things experienced by other Black students or professors. Marcus was from a neighborhood in St. Louis close to Ferguson and participated in the protests following Mike Brown’s murder when he was still in high school. He said, “Violent racism...scares me because, you know, obviously I assume the worst is gonna come next. So I look at [videos of violent racism] because I obviously have to be aware of what’s happening in America but at the same time, it always depresses me to watch, especially cause—I remember I cried during what was happening over at the University of Virginia [the KKK rallies], especially because I was very close to going to that school. So I know I have to be aware of it, so I do watch it but it leaves a scar on me every time and I realize that one day, that scar might get too big and you know—I’m going to have to look for some help for it.”

Methods of coping. In addition to describing experiences with racism and discrimination, we spent a significant portion of each focus group talking about strategies that the participants used to cope with these kinds of negative events and interactions. Numerous coping strategies were engaged *in anticipation* of experiencing a negative or discriminatory interaction, *in response* to experiencing discrimination, and *in daily life* to support general health and wellbeing.

When *anticipating* negative interactions, several participants reported **changing their behavior** to avoid potentially problematic situations or areas on campus where they

expect to experience discrimination. This included physical areas on campus, such as Greek town, as well as often occurring situations, like speaking up about race-related issues in class. Sarah said, “I’m usually like one of the few of the black females in the room so I don’t wanna be like the, you know, ‘power to the people’ type. I don’t want to be marked like that. Every time I raise my hand they gone look at me like, ‘oh, here she goes’. I don’t wanna be that person.” Thus, she avoids speaking up to avoid drawing negative attention. When avoiding the situation or place wasn’t possible, several participants reported **mentally preparing for the interaction ahead of time**. This preparation could include putting themselves into a positive mindset ahead of time or making themselves feel powerful using power posing, preparing to engage in emotion regulation so as not to appear angry or frustrated, engaging in self-care practices, and relying on social relationships beforehand for advice and support. Lisa talked about a particular situation where she had a meeting with several administrators about a problem in an organization she was a member of, with whom she had already had several negative interactions. She said, “I had to mentally prepare myself for that meeting. I remember, [a mentor] told me before we went in this meeting that, ‘Do not allow them to gaslight you...They’ve already attempted to try to make it seem like you are a problem child because you didn’t get your way and so just play it cool’—well that’s pretty hard to do when people are obviously problematic and prejudiced. Inside I wanted to flip the table on the man, honestly. But outside, how I really prepared was I ate breakfast, I called my mom, I really just—it’s hard, because even though I did all of that, my heart was still beating with anger sitting in front of these people.”

In *response* to everyday microaggressions, several participants said they **try not to let it bother them**, and learned when they came to Mizzou that they can't spend the emotional energy on reacting since microaggressions are so commonly part of their regular life. Kerri said, "I usually just brush it off or I'll just let it go. But a couple of years ago I know I wouldn't have done that—My hometown was pretty much, mostly black. But...moving here and stuff I kind of got used to it, which I'm not sure is a positive or a negative—it's my environment so I just let it because I can't let it—like I can't let that affect me if it's gonna happen every day." While this was a common strategy reported, there is evidence that everyday microaggressions, despite efforts to ignore and move past them, have a lasting effect on cortisol and potentially health in the long run (Zeiders et al., 2018), suggesting it is not easy to simply brush off these kinds of experiences.

Participants also reported **confronting** the person who had said or done something problematic, including when it was unintentional or the other person was unaware that what they said or did was hurtful or negative. In some cases, confrontation allowed for a release of anger and frustration, and was a form of defending oneself. However, June talked about how she engages in confrontation as a form of friendship and respect, to teach a friend why what they had done was wrong. Describing a situation in which their friend said something particularly insensitive, she said, "There's something that needs to be reconciled. There's something that needs to be fixed. And if I care about you, I don't want you to go around somebody else and say these things and then they check you and it's a big problem. So I usually—I feel as though it's for the benefit of others I try and say something." Additionally, when confrontation was used as a form of

education, participants reported doing a number of things to effectively encourage change, such as staying calm and not escalating, empathizing with the other person, waiting until later to start the discussion to give negative emotions time to dissipate, and using the “sandwich” method—sandwiching constructive criticism with positive statements like “I know you didn’t mean it...” or “I see where you’re coming from...”—to reduce defensiveness in the other person. Participants reported often feeling like they were responsible for producing a positive and constructive environment in which to confront someone else about their behavior, and that in order to create positive change, they engaged in a number of emotionally effortful strategies to manage the other person’s emotions.

Because of the emotional nature of confrontation, especially prolonged confrontation, participants also discussed the harmful consequences and how sometimes withdrawing from that confrontation is necessary for self-protection. In Lisa’s ongoing situation in the service organization where she experienced repeated discrimination, including throughout conversations with administrators and faculty in which she tried to make her concerns known and create positive change, her boyfriend and close friends eventually became concerned about her health and wellbeing and she “really kind of withdrew completely because usually I’m the person that’s talking to other [Black] people and encouraging them [to confront], especially when it comes to things like this but with that situation because it was so hurtful ... it was just a lot. I think my biggest way to cope now, and I’m still working through it, is really withdrawing and finding a place where I feel safe, where I feel peaceful.” However, even that decision had consequences. She explained, “I think that the hardest thing about really withdrawing

myself from the program was because I had friends that were black and brown as well as friends who were white that were telling me, ‘Well, I think you should just kind of like—you should still lead the trip, you should still kind of stay in that environment,’ even when it was terrible. It was really hard being the only one who looked like me and ... going to meetings where you knew how people felt about you but really just having to kind of—being like well I’m doing a good thing and I’m making an impact, and other students that will look like me will look up to me and be like, hey I can do this, this is possible. So, I think the [thing that was] the most difficult with me and for that situation is really just sticking to my gut, walking away, and saying I have to pick Lisa first.”

Lastly, participants described several ongoing strategies to maintain general health and wellbeing in their daily lives, despite an environment that at times feels unwelcome. A number of participants reported the importance of having a sense of purpose or larger perspective. For some, this including attending **church or having a sense of spirituality** that helped them achieve a more global, humanist perspective. Emily said, “Just believing that I have worth in something else besides like who I am as person, my race, and everything, it’s—it’s awesome and my church itself has been very supportive since I’ve been here.” Briana said, “[I’m] trying to keep in mind that it’s not about me, it’s about God.” For others, a **sense of purpose** comes from remembering the end goal of being a student at Mizzou—remembering their “why.” This included becoming a doctor to help underserved populations, becoming the representation that they wanted to see, and being able to create change and give back to Mizzou in the future. Blake was motivated by being a role model for future generations, “Because that’s

one way to be an activist as well, to just show black excellence.” Emily also reported finding purpose through activities like volunteering and giving back to the community.

Most importantly, the **role of friends and family** was pivotal through all of these situations and strategies. Friends and family provided emotional support, validation, and an outlet to vent frustration, anger, and other negative emotions in a safe space with someone who understands. Validation especially was very important to several participants, since many participants felt like their non-Black friends or classmates didn’t understand their experiences as a Black student at Mizzou. Emily said she calls her friends who are also Black and at different universities “just so I can hear somebody say ‘me too,’ and like that’s it—that’s all I want. My friends here, I don’t think that they’re ignoring the things that I say, but they—sometimes they just can’t relate...and so just to call someone and us be able to say, yeah I get it, that’s it. That’s like a huge relief for me sometimes.” Kay said she would have conversations with the two other Black students on her floor until 4 o’clock in the morning: “It’s like a thing to get all of your anger and your frustrations out. It’s really helpful to talk to people who understand what you’re talking about and so just talking to them for like, hours at a time—maybe like once every month was really helpful. It’s kind of like—it didn’t de-escalate the situation but it kind of brought it down a little bit so that you could at least breathe a little bit.” Especially in the cases of experiencing everyday microaggressions that are ambiguous and non-Black peers may not perceive as being discriminatory, validation from others who experience similar things and understand what the person is feeling seems particularly important for someone’s wellbeing and ability to overcome hardship so they can succeed as a student.

Quantitative Data Collection

Following the focus groups, a new sample was recruited to complete the quantitative portion of the study.

Participants

One-hundred and fifteen individuals (89 women, 24 men, 2 transgender/non-binary people) participated in exchange for credit towards a course requirement, or for monetary compensation. Participants were recruited through word of mouth, university newsletters, and flyers shared by Black student organizations. To be eligible, participants had to: (A) identify as African-American, (B) be fluent English speakers, (C) own a smartphone and (D) have a hairstyle that is compatible with the EEG caps (e.g., no weaves, braids, or locs) or be willing to change their hairstyle prior to the EEG portion of the experiment. Participants were all current undergraduate or graduate students and ranged in age from 18 to 45 years old ($M = 20.6$). All self-identified as African-American or Black. Of these participants, 74 participated in the EEG portion of the study.

Procedure

Participation in the study consisted of three stages. First, participants came to the lab for an initial training session (1 hour). Then, participants participated in the Ecological Momentary Assessment (EMA) period (28 days). Then, participants came back to the lab to participate in a psychophysiological assessment session (2 hours). The psychophysiological assessment was scheduled to occur within the two weeks preceding or following the end of the EMA period.

Training Session. After informed consent was provided, I introduced the TigerAware app that participants would use to report their experiences and mood during

the EMA period. All participants downloaded the TigerAware app on their phone. Because of technical difficulties with the Android app, some participants with Android phones were given iPhones from the lab to use for participation. I explained what prompts the TigerAware app would deliver and how often, how to respond to them, and how compliance would be tracked. Participants also completed a training survey in the app that introduced them to different kinds of items, and provided an example notification. Once everyone was familiar with how to use TigerAware, participants completed a questionnaire with the following measures.

Patient Health Questionnaire (PHQ-9; Kroenke & Spitzer, 2002). The PHQ-9 assesses depression symptoms over the past two weeks. Participants were asked, “Over the past 2 weeks, how often are you bothered by any of the following problems?” The eight problems included little interest or pleasure in doing things; feeling down, depressed, or hopeless; trouble falling asleep, staying asleep, or sleeping too much; feeling tired or having little energy; poor appetite or overeating; feeling bad about yourself—or that you’re a failure and have let yourself or your family down; trouble concentrating on things, such as reading the newspaper or watching television; moving so slowly that other people could have noticed, or the opposite—being so fidgety or restless that you have been moving around a lot more than usual. The last item (“Thoughts that you would be better off dead or of hurting yourself in some way”) was not included because of IRB concerns. The scale responses were Not at all (0), Several days (1), More than half the days (2), and Nearly everyday (3). Responses were summed together and higher summed scores indicated more depressive symptoms with the following cutoffs: 5-9 = mild; 10-14 = moderate; 15-19 = moderately severe, 20-27 = severe.

GAD-7 (Spitzer et al., 2006). The GAD assesses anxiety symptoms over the past two weeks. Participants were asked, “Over the past 2 weeks, how often are you bothered by any of the following problems?” The seven problems included feeling nervous, anxious, or on edge; not being able to stop or control worrying; worrying too much about different things; trouble relaxing; being so restless that it is hard to sit still; becoming easily annoyed or irritable; feeling afraid as if something awful might happen. The scale responses were Not at all (0), Several days (1), More than half the days (2), and Nearly every day (3). Responses were summed together and higher summed scores indicated more depressive symptoms with the following cutoffs: 0-4 = minimal; 5-9 = mild; 10-14 = moderate; 15-21 = severe.

Major and Everyday Racial Discrimination Scale (Williams et al., 1997).

Participants were asked whether and how often they had experienced different forms of discrimination in their lifetime (major discrimination) and in the past year (everyday discrimination). To assess major discrimination, participants were asked whether in their lifetimes they had experienced being unfairly fired or denied a promotion; not been hired; or been unfairly stopped, searched, questioned, physically threatened or abused by the police because of their race (0 = No; 1 = Yes). To assess everyday discrimination, participants were asked how often the following events happened to them in the past year because of their race: 1) Treated with less courtesy than others; 2) Treated with less respect than others; 3) Received poorer service than others in restaurants or stores; 4) People acting as if they're not smart; 5) People acting as if they're better than them; 6) People acting afraid of them; 7) People thinking they are dishonest; 7) Being called names or insulted; and 8) Being threatened or harassed. The response categories were

Almost every day (1), At least once a week (2), A few times a month (3), A few times a year (4), Less than once a year (5), and Never (6). Items for everyday discrimination were summed and reverse coded so that higher values indicate more everyday discrimination (i.e., these events occur more often).

Vigilant Anticipatory Coping Scale (Clark et al., 2006). The Vigilant Anticipatory Coping Scale assesses vigilant coping in response to experiencing discrimination. It is given immediately following the Everyday Racial Discrimination Scale and asks in reference to the everyday discrimination that participants just reported: how often do you 1) Think in advance about the kinds of problems you are likely to experience; 2) Try to prepare for possible insults before leaving home; 3) Feel that you always have to be very careful about your appearance (to get good service or avoid being harassed); 4) Carefully watch what you say and how you say it; 5) Carefully observe what happens around you; and 6) Try to avoid certain social situations and places. The response categories were Almost every day (1), At least once a week (2), A few times a month (3), A few times a year (4), Less than once a year (5), and Never (6). Items were summed and reverse coded so that higher values indicate more vigilant anticipatory coping (i.e., participants engaged in vigilance more often).

Racism-Related Coping Scale (Forsyth & Carter, 2014). The Racism-Related Coping Scale assesses seven styles of coping with race-related discrimination: Racially Conscious Action, Empowered Action, Constrained Resistance, Confrontation, Hypervigilance, Bargaining, and Spiritual Coping. Participants were asked: “In response to situations in the past where you were treated unfairly because of your race, how often did you engage in the following things to deal with those situations?” with the following

response options: Never (1), Sometimes (2), Often (3), and Almost Always (4). The Racially Conscious Action subscale included 9 items, including, “I participated in organized efforts to combat racism and/or support Black people,” and “I made a conscious decision to try to patronize only Black-owned businesses and establishments.” The Empowered Action subscale included 9 items, including, “I sought legal advice,” and “I demanded to speak to someone with greater authority (manager, supervisor, etc.).” The Constrained Resistance subscale included 6 items, including, “I only did the bare minimum to get by in my job as a form of resistance,” and “I exaggerated my anger in order to intimidate the person(s) involved.” The Confrontation subscale included 7 items, including, “I talked about it with the person(s) involved in order to educate them,” and “I expressed my anger to the person(s) involved.” The Hypervigilance scale included 11 items, including, “I became more careful about what I say and do around people who are not Black,” and “I thought constantly about why this happened to me.” The Bargaining subscale included 6 items, including, “I looked for an explanation other than racism,” and “I tried to convince myself that it wasn’t that bad.” The Spiritual Coping subscale included 7 items, including, “I read passages in the Bible (or other religious text) to give me strength and/or guidance,” and “I meditated.” Items were averaged separately for each subscale. Higher scores represented using that coping strategy more often.

The Rosenberg Self-Esteem Scale (Rosenberg, 1965). Participants are asked to indicate their agreement with 10 items assessing their self-esteem, including, “I feel that I’m a person of worth,” “I feel that I have a good number of qualities,” and “On the whole, I am satisfied with myself.” Items were summed and higher scores represent more self-esteem.

Vicarious Experiences of Racism Scale (Chae & Yip, unpublished). The Vicarious Experiences of Racism Scale assesses how often participants hear about or see others experiencing racial discrimination. Participants are asked: “Think about the experiences of Black or African Americans. How often do you see or hear the following things?” Examples of the 13 items include: “Hear about or see Black family members experiencing racism”; “Hear about or see Black friends experiencing racism”; “Hear about or see professors or instructors at your college/university treating Black people unfairly because of their race”; “Hear about other Black people being the victims of racism in the news”; “Hear politicians saying racist things about Blacks”; and “Hear about or see racist things about Blacks posted on social media”. The response categories were Almost every day (1), At least once a week (2), A few times a month (3), About once a month (4); A few times a year (5), Less than once a year (6), and Never (7). Items were summed and reverse coded so that higher values indicate more vicarious discrimination experienced (i.e., participants saw others experiencing discrimination more often).

Multigroup Ethnic Identity Scale (MEIM; Phinney, 1992). The MEIM assesses how important one’s ethnic/racial identity is along three subscales: Affirmation and Belonging, Ethnic Identity Achievement, and Ethnic Behaviors. The Affirmation and Belonging subscale consists of 5 items, including, “I am happy that I am a member of the group I belong to”; “I have a strong sense of belonging to my own ethnic group”; and “I have a lot of pride in my ethnic group and its accomplishments”. The Ethnic Identity Achievement subscale consists of 7 items, including “I have spent time trying to find out more about my own ethnic group, such as its history, traditions, and customs”; and “I

have a clear sense of my ethnic background and what it means for me”. The Ethnic Behaviors subscale consists of 2 items: “I am active in organizations or social groups that include mostly members of my own ethnic group”; “I participate in cultural practices of my own group, such as special food, music, or customs.” Items were averaged and higher scores indicate stronger ethnic identity. The MEIM also includes 6 items that assess other-group orientation independently from ethnic identity, which includes items such as, “I like meeting and getting to know people from ethnic groups other than my own”; “I enjoy being around people from ethnic groups other than my own.” Higher scores indicate more other-group orientation.

Multidimensional Inventory of Black Identity (MIBI; Sellers et al., 1997).

Similarly to the MEIM, the MIBI assesses the strength of Black identity along a number of subscales, although only the Centrality subscale was administered. Participants are asked to indicate their agreement on a Likert scale (1 = strongly disagree; 7 = strongly agree) with 8 statements, including, “In general, being Black is an important part of my self-image”; “I have a strong sense of belonging to Black people”; “Being Black is an important reflection of who I am”; and “Being Black is not a major factor in my social relationships (reverse scored)”. Items were averaged and higher scores indicate a stronger Black identity.

Demographics. Participants completed a number of demographic questions as well, including how many semesters they had been at Mizzou, their current GPA and major, the zip code they grew up in and where they went to high school, estimated percentage of Black students at their high school, gender, sexual orientation, age, SES (as

measured by mother/father education and family income), mother/father ethnicity, and how many hours of sleep they usually got per night.

Ecological Momentary Assessment (EMA) Period. Over the course of 28 days, participants completed *event-based reports* and *random prompts* using the TigerAware app. Participants initiated an event-based report following any interaction or event in which they felt they were treated differently because of their race, including both positive and negative interactions. Participants were encouraged to report events that they suspected may be race-related, even if not they were not certain, due to the often-ambiguous nature of interpersonal interactions. In each event-based report, participants first completed the negative and positive affect scales from the PANAS-X (Watson & Clark, 1999), plus three additional items measuring anxiety-related symptoms (anxious, worried, restless) and three additional items measuring depression-related symptoms (depressed, sad, lonely). Participants reported the extent to which they felt each emotion on a scale from 1 (“Very slightly or not at all”) to 5 (“Extremely”).

Then, participants responded to questions specific to the race-related event. First, they reported what happened, either by selecting items from the list provided or by describing the event in a free-response box. The list provided was developed previously existing scales for self-reporting discrimination and additional experiences described during the focus group discussion (see Table 2). After describing the interaction, participants answered the following questions: “To what extent do you think this happened because of race?” (responses: Definitely not because of my race; Probably not because of my race but could be interpreted that way; Probably because of my race but not certain; Definitely because of my race; I don’t know); “What was the gender of the

person who was primarily responsible?” (responses: Male; Female; Trans/Non-Binary; I don’t know); “What was their race?” (responses [select all that apply]: Non-Hispanic White/European American; Black/African American; Asian; Native American/Pacific Islander; Hispanic; I don’t know); and “What category best describes your relationship with this person?” (responses: Classmate; Friend/Acquaintance; Roommate; Romantic partner (girlfriend/boyfriend); Family member; Professor or teaching assistant; Stranger).

Independently from the event-based reports, participants received three random prompts per day between 9 am and 10 pm. Each random prompt contained the same emotion items as the event-based reports. Participants were then asked if any race-related events had occurred since their last completed prompt that they had not reported; if participants responded, “Yes,” they were given the race-related event items, plus an item asking approximately what time the event had occurred. Each random prompt was expected to take less than 5 minutes to complete.

To encourage compliance, participants were compensated in person two weeks into the study, and again at the end of the EMA period, with a bonus if they completed at least 80% of the prompted reports (67 of 84 random prompts). As the bonus was not contingent on event-based reports, participants did not have an incentive to over-report race-related events. Participants additionally had the ability to suspend random notifications during times they would be unable to respond, such as when they were driving or when they were taking a test. On average, compliance rates were acceptable (mean = 84%; min = 54%; max = 98%).

Participant Exclusions. Of the 115 enrolled in the study, 3 withdrew because of technological difficulties and 1 withdrew after giving consent because she had previously

participated and but did not realize it until after consenting to participate a second time (her first participation in the study was included). One participant incorrectly used the event-based prompt instead of responding to the random prompts throughout the EMA period and was therefore excluded due to concerns that his affect and mental health were not randomly sampled. Thus, 110 participants' EMA data were used in analyses.

Psychophysiological Assessment. Within two weeks of completing the EMA period, participants were scheduled to come back into the lab for the psychophysiological assessment session. Of the 115 participants who enrolled in the EMA portion of the study, 74 (50 women, 22 men, 2 trans/non-binary) completed the psychophysiological assessment session. During the session, participants were first set up with the EEG recording equipment and then completed two behavioral tasks administered using E-Prime while EEG was recorded. EEG data were collected using 33 tin electrodes.¹ All scalp electrodes were referenced online to the right mastoid; an average mastoid reference was derived offline. Signals were amplified with a Neuroscan Synamps amplifier, filtered on-line at .05–40 Hz at a sampling rate of 500 Hz. Impedances were kept below 10 K Ω . Ocular artifacts (i.e. blinks) were corrected from the EEG signal using a regression-based procedure (Semlitsch et al., 1986). During the psychophysiological assessment, participants completed a dot-probe task and a categorization task, described next.

¹ EEG was recorded at FP1, FP2, Fz, F1, F2, F3, F4, FCz, FC3, FC4, Cz, C1, C2, C3, C4, CPz, CP3, CP4, Pz, P1, P2, P3, P4, POz, PO5, PO6, PO7, PO8, Oz, TP7, TP8, T5/P7, and T6/P8. Additional electrodes were placed above and below the left eye and on the outer canthus of each eye (to record blinks and saccades) and over each mastoid.

Dot-probe Task. Participants first completed 8 practice trials, followed by 448 experimental trials. The trial structure is depicted in Figure 1. On each trial, a fixation cross was presented in the middle of the screen (jittered: 1400 ms, 1500 ms, 1600 ms). Then, color photos of two faces were presented to the left and right of the fixation cross (400 ms). Both faces were of the same individual, one with an angry expression and one with a neutral expression. Face stimuli were taken from the Chicago Face Database (Ma et al., 2015) and included faces of Black men and White men. Following the face cues, a blue or green checkerboard appeared in either the right or left location (100 ms). Participants were asked to identify within 800 ms whether the checkerboard was blue or green using their right thumb or right index finger on a game controller. If they did not respond by the response deadline, they received feedback saying “TOO SLOW” (750 ms). To ensure that eye movement artifacts would not contaminate the EEG recordings and influence measurement of the N2pc, participants were instructed to maintain eye fixation in the center of the screen throughout the trial. Trial type varied randomly and participants took breaks every 32 trials.

Categorization Task. Participants completed two trial blocks, each containing 128 trials, in which they categorized the same set of faces by race (Black or White) or by gender (male or female; task order was randomized across participants). Trial structure and timing were the same in both blocks. In each block, participants completed 4 practice trials followed by 128 experimental trials. On each trial, a fixation cross was presented (jittered: either 500, 650, or 800 ms), followed by a Black or White male or female face, presented in grayscale (270 ms). The faces were taken from the Chicago Face Database and were equated for brightness and contrast using the SHINEd toolbox in Matlab

(Willenbockel et al., 2010). Then, a visual mask was presented (530 ms). Failure to respond within 800 ms following face onset elicited a ‘TOO SLOW’ warning displayed for 1000 ms. The ITI was 600 ms. Trial type varied randomly, with 32 trials of each type (Black-male; Black-female; White-male; White-female) presented total. Participants took brief breaks half-way through each block.

Deriving ERP Waveforms

Deriving N2pc Waveforms. To create cue-locked waveforms in the dot-probe task, I created epochs from 100 ms before the cue (face) onset until 1000 ms after the cue onset. Epochs containing deflections ± 75 μV at P7/P8 and surrounding electrodes² and epochs with incorrect responses were rejected. Epochs containing horizontal eye movements were also discarded, given the overlap between HEOG activity and the N2pc. Removal of all HEOG activity was confirmed using a procedure described by Luck (2005) where average HEOG is computed for left and right angry face trials separately. Average HEOG activity was $< \pm 3$ μV for all subjects within the window used to quantify the N2pc, indicating no systematic horizontal eye movements that could be confused for the N2pc. The HEOG channel was bad for three participants, so I was unable to reject trials based on horizontal eye movements. However, I ran the analyses with data from these three individuals included and with their data excluded, and the pattern of results was the same. Thus, I kept them in the analyses in order to maintain as large a sample as possible.

The contralateral waveform was calculated as the average of the right-side electrode (P8) to left-sided angry faces and left-side electrode (P7) to right-sided angry

² PO7/PO8, TP7/TP8, P3/P4, PO5/PO6

faces, whereas the ipsilateral waveform was computed as the average of the left-side electrode (P7) to left-sided angry faces and right-side electrode (P8) to right-sided angry faces. For all participants included in the analyses, an average of 189 trials were included in each waveform (min: 155; max: 219). The N2pc was measured from 170-220 ms following cue onset to be consistent with previous studies (e.g., Eimer & Kiss, 2007; Fox et al., 2008; Li et al., 2019), although the literature varies widely in terms of the window the N2pc is measured in. Because the N2pc is a lateralized component, the occurrence of a reliable N2pc will be indicated by a significant effect of contralaterality.

Participant Exclusions. Seventy-four participants completed the dot-probe task while EEG was recorded. For three participants, a coding malfunction resulted in trigger codes for cues not being recorded, so cue-locked waveforms could not be produced. Three participants had fewer than 150 trials included in the computation of either or both of the contralateral/ipsilateral waveforms and were therefore excluded due to inability to create reliable N2pc waveforms. As a result, 68 participants contributed data to N2pc analyses.

Deriving P2 Waveforms. To create target-locked waveforms in the categorization task, I created epochs from 100 ms before the target (face) onset until 1000 ms after the target onset. Epochs containing deflections +/- 75 uV and epochs with incorrect responses were rejected. Averaged waveforms were created separately for each stimulus type (Black-male, White-male, Black-female, White-female), and separately for the race categorization and gender categorization blocks. For all participants included in the analyses, an average of 27 trials were included in each waveform (min: 11; max: 32).

The P2 was quantified from 130-190 ms post-face-onset at centro-parietal electrodes³, consistent with previous studies (Volpert-Esmond et al., 2017; Volpert-Esmond & Bartholow, 2019).

Participant Exclusions. Of the 74 participants who began the EEG portion of the study, 6 participants did not complete the categorization task because of time constraints. The categorization task was always completed last and thus technical difficulties during cap set-up that took longer than usual to resolve resulted in having to conclude the lab session before the participant completed the categorization task. One participant was additionally unable to complete the gender categorization block of the task because of time constraints, but did complete the race categorization block. Additionally, fewer than 50% of trials were accepted for three participants, who were thus excluded because of data quality concerns. Therefore, 65 participants contributed data to the race categorization analyses and 64 participants contributed data to the gender categorization analyses.

Statistical Approach

I used the R package lme4 (Bates et al., 2015) to fit multilevel models for data analysis. Satterthwaite approximations were used to estimate degrees of freedom and to obtain two-tailed p values; in situations where degrees of freedom were > 200, I report the results as z statistics. For each model, I used the most complex random structure that was supported by the data (i.e., I removed terms to avoid singular fit and terms that lead to high correlations between random effects; Matuschek et al., 2017).

³ The P2 was quantified at Cz, CPz, Pz, C1, C2, C3, C4, CP3, and CP4.

RESULTS

First, I describe the type and frequency of the events that were reported during the EMA period, followed by tests of Hypotheses 1A and 1B concerning the effect of the reported race-related events on affect, anxiety, and depression, as well as the alternative direction of causality described in Hypothesis 1C. Then, I present analyses related to the N2pc, first confirming the presence of a typical N2pc and then examining Hypotheses 2A-2C concerning the relationship between the N2pc and an individual's anxiety and its moderating influence on the experience of anxiety following race-related events. Last, I examine an alternative neurocognitive indicator of attention to threat (i.e., P2 differentiation to race). As with the N2pc, I first test for differentiation in P2 amplitude to Black and White faces to assess differences in attention to White and Black faces and confirm patterns shown in previous literature. Then, I test Hypothesis 3 by examining the relationship between P2 differentiation and reported discrimination. Last, although no specific hypotheses were presented, I examined the moderating influence of individual differences in the P2's sensitivity to race on the experience of anxiety following race-related events in an exploratory way.

Ecological Momentary Assessment

Frequency and Type of Events Reported

On average, participants reported 2.4 race-related events over the course of the 4-week EMA period, although the distribution of reported events was heavily skewed (min = 0; max = 29; see Figure 2). To separate the reported events into unique categories by theme, I used an iterative process in which three Black undergraduate research assistants and I proposed categories, rated each event as belonging to a category, refined the

categories in cases of disagreement, and repeated until we had majority agreement on the classification of each event. This process resulted in 6 unique categories of events: 1) Mistaken identity; 2) Spotlighting; 3) Assumption of inferiority; 4) Derogating jokes or comments; 5) Interpersonal antagonism or harassment; and 6) Being perceived as a threat. Examples are edited for clarity.

Mistaken identity referred to interactions in which the participant was mistaken for another black person or the perpetrator interacted with the participant as if they were interchangeable with any other Black person (example: “*There are three Black girls in my French class and the instructor refers to all of us as Dee. Dee is the name of the Black girl that rarely comes to class*”). Mistaken identity events composed 8.8% of all reported events.

Spotlighting referred to interactions in which the participant felt put on the spot to represent all Black people, or were viewed with heightened fascination (examples: “*In class we discussed race and social justice. [I’m the only Black person in class]. One girl talked about her situation between her and her AA neighbors in her dorm room. She then proceeded to ask what was the name of the African American building on campus...She then asked if White people can join African American organizations on campus? But turned to me and asked...expecting me to be the ‘spokesperson’ for Black people*”; “*A group of people of mixed races kinda approached my boyfriend and I and kept talking about how wonderful and beautiful our skin was and how we complimented each other so well: his ‘perfect caramel skin’*”). Spotlighting events composed 4.4% of all reported events.

Assumption of inferiority referred to interactions in which others acted superior, ignored or overlooked the participant, or assumed the participant was unintelligent or incompetent (example: *“My usual Chemistry lab partner was sick today, so I worked with someone else in today’s lab whose partner was also sick. Throughout the whole lab, he would tell me what to do next, what equipment I should keep out, and what I can go ahead and wash. One time he even took the pipet from my hand to measure a solution himself, even though I was measuring all the other solutions that we needed”*).

Assumption of inferiority events composed 26.0% of all events reported.

Derogatory jokes or comments referred to situations in which people made comments or jokes at the expense of Black people and created an environment in which the participant felt unwelcome (example: *“Someone made an insensitive joke about using people of color as Guinea pigs in experiments because they are a cheap and inexpensive source of research participants”*). Derogating jokes or comments composed 3.7% of all events reported.

Interpersonal microaggressions or harassment referred to interactions that communicated hostile, derogatory, or negative racial slights toward the participant, sometimes without the awareness or intention of the perpetrator (Sue et al., 2007). In creating this category, we did not separate events based on perceived intent or emotional intensity, so intentional harassment was also included. Thus, this category ranged from less upsetting situations, such as when participants were treated with less courtesy or respect than others or were bumped without the other person saying, “Excuse me,” as well as more major instances of discrimination, including being unfairly stopped, searched, or questioned by the police, or called racial slurs (example: *“I went to this*

mostly White party and it was just horrible. I felt like White boys felt they could touch me unnecessarily, one girl kept apologizing only to me like she was scared I would do something, I felt scared that anything could happen”; *“It was a minor event through a spades game app. Other participants can chat with you while you play. My icon picture is a Black woman flexing her muscles like the famous Rosie the riveter and above it says ‘We can do it’. Every now and then there’s a White man who has a problem with it and calls me a dumb [n-word]”*). Interpersonal microaggressions or harassment composed 42.5% of all reported events.

Being perceived as a threat referred to interactions or situations in which participants were treated as threatening or suspicious, including being accused of lying or theft (example: *“I was volunteering at a Black event for the Big 12 conference. Me and maybe five-seven other Black people were in a room and literally seven White cops were there on alert. It made us wonder why there were so many and two of them were standing up, in position staring while we were setting up chairs. I wasn’t the only one who noticed. My friend and another person made a remark about the need for all those police officers to be watching over us setting up chairs”*; *“I asked a friend to come sit with me but as she went to grab her stuff she said she didn’t trust me with her phone.”*) Being perceived as a threat composed 11.0% of all reported events.

Effect of Reported Incidents on Affect, Anxiety, and Depression (Hypotheses 1A-1C)

Hypotheses 1A and 1B concerned the acute and delayed effect of reporting a race-related event on affect and symptoms of depression and anxiety. For each outcome, I tested the effect of reporting a race-related event at three different delays: 1) The immediate effect of a reported event (outcome on prompt P); 2) The delayed effect

several hours later after a reported event (outcome on prompt P+1); and 3) The delayed effect the next day following a reported event (outcome on day D+1). To test the immediate effect, an aggregate of all items for a particular outcome on each given prompt was included as the dependent variable.⁴ Each unique outcome (positive affect, negative affect, anxiety symptoms, and depression symptoms) was examined in separate models. In each model, whether or not a race-related event had been reported on that prompt (prompt P) was included as a categorical predictor (No event = 0; Event = 1), along with the following covariates: 1) the day of the week to account for weekend effects; 2) participant gender; 3) participant age; and 4) the relevant outcome (positive affect, negative affect, depression, anxiety) on the preceding prompt (prompt P-1). To test the delayed effect of a reported event on the subsequent prompt, the models included the same predictors but rather than predicting the outcome on prompt P, these models included the outcome on prompt P+1 as the dependent variable. Additionally, all models included a random intercept by subject, as well as a random intercept by day in the study nested within subject.

In every model, positive affect, negative affect, depression, or anxiety on the previous prompt (prompt P-1) was the best predictor of positive affect, negative affect, depression, and anxiety, respectively, on prompt P. However, even when accounting for stability in affect and mental health outcomes across prompts, reporting a race-related event did have a unique effect on immediate negative affect, $b = 0.16, z = 4.88, p < .001$, depression, $b = 0.15, z = 3.22, p = .001$, and anxiety, $b = 0.18, z = 3.49, p < .001$, such

⁴ Positive affect: active, alert, attentive, determined, excited, inspired, proud, strong; Negative affect: afraid, scared, nervous, jittery, irritable, hostile, guilty, ashamed, upset, distressed; Depression: depressed, sad, lonely; Anxiety: anxious, worried, restless.

that these outcomes were all higher on prompts when an event was reported compared to prompts with no reported event (see Figure 3). Immediate positive affect did not differ as a function of reporting an event, $p = .477$. This is consistent with the conceptualization of discrimination as an acute stressor (Clark et al., 1999; Lockwood et al., 2018). No other covariates had a significant effect, with the exception of the effect of gender on positive affect, $b = .12$, $z = 2.35$, $p = .021$, such that men reported higher positive affect than women overall. However, given the underrepresentation of men in the sample, this apparent gender difference should be interpreted with caution.

Next, I examined the effect of reporting a race-related event on outcomes measured on the following prompt (P+1). As when examining outcomes on prompt P, the best predictor was affect or anxiety/depression symptoms on the previous prompt (prompt P-1). Reporting an event did not have a significant effect on negative affect, depression, or anxiety on the following prompt, $ps > .469$. In fact, reporting an event had a significant effect on positive affect, $b = 0.25$, $z = 3.37$, $p = .001$, such that positive affect was more positive on prompts following a reported event than prompts following no reported event (see Figure 3).

Lastly, I examined the effect of reporting a race-related event on outcomes measured the following day. In these models, aggregate scores for negative affect, positive affect, depression and anxiety were aggregated for each day. Outcomes on Day N+1 were predicted by whether or not a race-related event was reported on Day N, day of the week, participant age and gender, and the relevant outcome on Day N-1. As before, the best predictor of anxiety, depression, negative affect, and positive affect on Day N+1 was previous levels of each outcome reported on Day N-1. When accounting for previous

day's outcome, participant gender, and participant age, the effect of a reported event on next day outcomes was not significant for any of the four outcomes, $ps > .354$ (see Figure 4).

Effect of Anxiety and Depression on Reporting Race-Related Events

Hypothesis 1C regarded the role of anxiety and depression in the construal of an interaction as race-related and, thus, worthy of reporting. To test the possibility that individuals with elevated anxiety or depression in general may perceive more interactions as discriminatory, I first looked simply at the correlation between the number of events reported by each individual and their self-reported trait anxiety (GAD-7 score) and self-reported trait depression (PHQ-9 score). Neither trait anxiety, $r = -.09$, $p = .350$, nor trait depression, $r = .01$, $p = .883$, were significantly correlated with the number of race-related events reported. Second, instead of relying on a single self-report of trait anxiety or depression, I averaged across all reports of momentary anxiety and depression symptoms during the EMA period and compared it to the number of race-related events reported. The number of EMA race-related events reported did not correlate with aggregate anxiety measured over the EMA period, $r = .09$, $p = .345$, but (marginally) correlated with aggregate depression measured over the EMA period, $r = .20$, $p = .047$, such that higher depression reported on average over the EMA period was related to more reports of race-related events.

However, these correlational approaches cannot establish temporal precedence, which is needed to assert that feeling anxious or depressed causally increases the probability that a person will construe an interaction as discriminatory. Thus, I used multilevel models to examine the difference in anxiety and depression on prompts as a

function of whether or not a race-related event was reported on the subsequent prompt, controlling for gender and age. These models included whether or not a race-related event had been reported on prompt P as a categorical predictor (No event = 0; Event = 1), along with the day of the week, age, and gender as covariates. The dependent variable was the outcome on the preceding prompt (prompt P-1). Anxiety on prompt P-1 did not significantly differ as a function of whether or not a race-related event was reported on Prompt P, $b = .06$, $z = 1.31$, $p = .192$. Depression was marginally different, $b = -.08$, $z = -1.85$, $p = .064$, but in the opposite direction suggested by the correlational relationship between aggregate depression and number of reports, such that depression was *lower* on prompts preceding prompts reporting an event compared to prompts preceding prompts not reporting an event. Thus, there is no consistent or strong evidence for the hypothesis that elevated momentary or trait anxiety or depression makes people more likely to construe an interaction as discriminatory.

Psychophysiological Assessment

N2pc in the Dot-Probe Task

Confirming the Presence of a Typical N2pc. To confirm the presence of a typical N2pc indexing attention to the angry faces, I first tested the effects of race (Black = -1, White = 1) and contralaterality (contralateral = -1, ipsilateral = 1) on mean amplitude. As expected, the effect of contralaterality was significant, $b = 0.07$, $z = 2.26$, $p = .025$, such that mean amplitude was more negative contralateral to the location of the angry face relative to the ipsilateral location. This indicates that participants covertly shifted their attention to the angry faces, consistent with previous literature (Feldmann-Wüstefeld et al., 2011; Grimshaw et al., 2014; Holmes et al., 2009, 2014; Weymar et al.,

2011; for a review, see Torrence & Troup, 2018). Neither the effect of race, $b = -0.03$, $z = -1.04$, $p = .299$, nor the Contralaterality x Race interaction, $b = 0.04$, $z = 1.34$, $p = .182$, was significant.

Although the Contralaterality x Race interaction was not significant, because of a priori predictions that the N2pc might differ by race, I tested the simple effect of contralaterality for trials presenting White faces and Black faces separately. The simple effect of contralaterality for Black faces was not significant, $b = 0.03$, $t(67.0) = 0.98$, $p = .331$. However, the simple effect of contralaterality for White faces was significant, $b = 0.11$, $t(67.0) = 3.29$, $p = .002$, suggesting that participants specifically shifted their attention to angry White faces relative to neutral White faces (see Figure 5).

N2pc and Anxiety (Hypothesis 2A). Past literature has linked attention to threat, as indexed by the N2pc, to the development and maintenance of anxiety (MacNamara et al., 2013). Thus, I examined the relationship between the general N2pc (collapsing across face race) and 1) Self-reported trait anxiety (GAD-7), and 2) An aggregate of momentary anxiety aggregated across the entire EMA period. Unexpectedly, the overall N2pc was not related to trait anxiety measured by the GAD-7, $r = -.21$, $p = .084$, nor aggregate anxiety from the EMA responses, $r = -.18$, $p = .144$. However, outgroup-specific vigilance (i.e., N2pc on the White trials) was significantly associated with anxiety reported during the EMA period, $r = -.28$, $p = .025$, such that more vigilance (i.e., a more negative N2pc) was associated with more momentary anxiety aggregated over the EMA period (see Figure 6). The relationship between N2pc amplitude and trait anxiety was not statistically significant, $r = -.21$, $p = .087$.

N2pc and Discrimination (Hypotheses 2B-C). Hypotheses 2B and 2C

concerned the relationship between the N2pc and the effects of discrimination. I first examined how biased attention to threatening White faces is related to the frequency of experiencing discrimination. Outgroup-specific vigilance did not correlate with the number of EMA reports, $r = .15$, $p = .150$, nor self-reported past year discrimination, $r = -.06$, $p = .618$.⁵ However, self-reported vigilant coping (Clark et al., 2006) and self-reported hypervigilance (Forsyth & Carter, 2014) were both significantly related to both self-reported past year discrimination, $r = .65$, $p < .001$, and $r = .48$, $p < .001$, such that more vigilance was related to experiencing discrimination more frequently over the past year, although this did not hold when examining the number of EMA events reported, $r = .18$, $p = .144$, and $r = .21$, $p = .096$, respectively.

Although N2pc amplitude was not related to overall levels of discrimination, I tested Hypothesis 2C that N2pc amplitude may moderate the effect of discrimination on the experience of anxiety. Thus, I added outgroup-specific vigilance as a level-2 predictor to the models examining the effect of race-related events on anxiety on the same prompt and the following prompt. Other predictors and covariates remained the same. The cross-level interaction between N2pc amplitude and whether or not a race-related event was reported was not significant when predicting same prompt anxiety, $b = .11$, $z = 0.76$, $p = .448$, and following prompt anxiety, $b = .04$, $z = 0.34$, $p = .736$.⁶ Thus, there is no evidence that individual differences in neurocognitive indices of vigilance moderate the influence of discrimination on anxiety.

⁵ Additionally, the general N2pc (measured across both White and Black trials) did not correlate with either measure of frequency of discrimination, $ps > .229$.

⁶ Additionally, neither the outgroup-specific N2pc nor the general N2pc moderated the effect of race-related events on any of the other facets on same prompt or follow prompt.

P2 in the Categorization Task

Differences in P2 By Race of Target. First, to confirm the presence of the well-established sensitivity of the P2 to race, I used a multilevel model with Race (effect-coded: Black = -1, White = 1), Gender (effect-coded: Female = -1, Male = 1), Task (effect-coded: Gender categorization = -1; Race categorization = 1) and their interactions included as predictors. The dependent variable was P2 amplitude measured from individual averages created using the signal averaging approach. All three predictors and their interactions were included as random slopes by subject, and the intercept was additionally allowed to vary by electrode. The effect of Race was significant, $b = -0.20$, $t(63.7) = -3.14$, $p = .003$, such that Black faces elicited larger P2s than White faces. This pattern contrasts with studies that show a larger P2 to White faces relative to their ingroup among Black and Asian participants (Dickter & Bartholow, 2007; Willadsen-Jensen & Ito, 2008), and instead is similar to the pattern shown by White participants (for review, see Ito & Bartholow, 2009). Additionally, the effect of Task was significant, $b = 0.21$, $t(63.1) = 2.57$, $p = .013$, such that P2 amplitude was larger in the race categorization task than the gender categorization task. The effect of gender and all the interactions were not significant, $ps > .44$.

P2 and Discrimination (Hypothesis 3). Although the main effect of race was not consistent with the hypotheses that outgroup faces elicit more attention because they are threatening, I still investigated whether the difference in P2 to Black and White faces moderates the experience of anxiety following race-related events. Separate average waveforms elicited by White and Black faces were created by averaging across target gender and task. A difference waveform was then created by subtracting the White

waveform from the Black waveform for each individual so that positive values of $\Delta P2$ represented larger P2 amplitude to Black faces relative to White faces. $\Delta P2$ was quantified from 130-190 ms post-target-onset using this difference waveform.

$\Delta P2$ was not correlated with the number of EMA race-related events reported, $r = .04$, $p = .754$, nor self-reported past year discrimination, $r = -.11$, $p = .397$. To test Hypothesis 3, as with N2pc amplitude, I added $\Delta P2$ as a level-2 predictor to the models examining the effect of race-related events on anxiety on the same prompt and the following prompt. Other predictors remained the same (e.g., relevant facet on previous prompt, whether a race-related event was reported, day of the week, gender, age). As with N2pc amplitude, the cross-level interaction between N2pc amplitude and reporting an event was not significant when predicting same prompt anxiety, $b = -.04$, $z = -0.49$, $p = .626$. However, $\Delta P2$ did significantly moderate the effect of reporting a race-related event on anxiety reported on the following prompt, $b = .24$, $z = 3.32$, $p = .001$, such that individuals with larger $\Delta P2$ values (larger P2 amplitude to Black compared to White faces) experienced a stronger effect of reporting a race-related event on anxiety on the subsequent prompt (more anxiety following a race-related event relative to no event; Figure 7).

DISCUSSION

Experiencing racial discrimination is substantially related to both mental and physical health, as demonstrated by three decades of research and several large meta-analyses (Mays et al., 2007; Pascoe & Richman, 2009; Schmitt et al., 2014). However, much of this research focuses on population-level relationships using cross-sectional samples and questionnaires, which is unable to establish causal relationships between the

experience of racial discrimination and mental health outcomes. The purpose of the current study was to establish temporal precedence by examining the effect of experiencing discrimination on both immediate and delayed outcomes relevant to mental health, as well as testing the alternative hypothesis—that elevated anxiety or depression increases the likelihood of someone perceiving a particular interaction as discriminatory. To accomplish this, I used an Ecological Momentary Assessment approach (Trull & Ebner-Priemer, 2013), which allows for repeated measurement of participants' affect, anxiety, and depression over the course of several weeks, as well as any interactions in which participants felt they were treated differently because of their race. Because of the nature of the repeated assessment, I could test the effect of a race-related event at several different delays and examined the immediate effect, the delayed effect on the subsequent prompt, and the delayed effect on the subsequent day.

The temporal pattern that emerged was quite complex. Reporting a race-related event had an immediate negative effect, resulting in higher levels of negative affect, depression, and anxiety on prompts when an event was reported relative to prompts where no event was reported. This is consistent with laboratory studies that have shown an acute effect of experiencing or witnessing discrimination on mental stress responses (Bennett et al., 2004) and physical stress responses (for review, see Lockwood et al., 2018). However, rather than seeing this negative effect persist until the next prompt, as has been shown in previous daily diary or EMA studies (Ong et al., 2013; Torres & Ong, 2010), there were no differences in negative affect, depression, and anxiety on the subsequent prompt (Prompt P+1) as a function of whether a race-related event was

reported on Prompt P. Instead, positive affect actually increased, which has not been reported in previous literature, to my knowledge.

To understand this pattern better, I conducted follow up focus groups with some of the people who had participated in the EMA portion of the study (N = 25). In these focus groups, we talked in part about what happens in those hours after a race-related event is reported, and why positive affect increases. Several possibilities were proposed to account for this effect: 1) That participants intentionally engaged in emotional regulation so that the other person would not “win” by ruining their day or making them feel bad; 2) That participants reached out to friends or family to vent about the event and receive validation and support; 3) That participants engaged in other self-care strategies to make themselves feel better, such as going to the gym or listening to music; and 4) That the act of reporting itself made participants feel empowered and relieved. Any and all of these possibilities may account for the increase in positive affect following the reporting of a race-related event and further research is needed to understand individual differences in how people respond to discrimination, and how these differences are important in understanding the consequences of discrimination for mental health.

Additionally, I examined the effect of reporting a race-related event on next day affect and mental health and found no continued effect, either positive or negative. Given the novelty of these results, it is unclear why no spillover into the next day is found, especially in contrast to studies that show a much longer duration of the effect of experiencing discrimination on physical health outcomes, including cortisol (Zeiders et al., 2018). It is possible that although certain emotion regulation strategies may be effective in addressing the psychological effect of discrimination, the experience of

discrimination continues to contribute to accumulated physical stress over a longer period of time. Future research should examine differences in the time course of the effect of discrimination on psychological outcomes versus physiological outcomes and how different factors, including intentional emotion regulation and social support, may affect one but not the other.

In addition to examine the effects that follow experiences of discrimination, I examined the possibility that elevated anxiety or depression increases the likelihood that someone perceives an interaction as discriminatory, as proposed by Lilienfeld (2017). This possibility is consistent with evidence that individuals with high trait anxiety are more likely to classify emotionally ambiguous faces as fearful (Richards et al., 2002) and ambiguous events as threatening (Constans et al., 1999). However, no evidence was found supporting this directional relationship in the current study. Instead, neither trait nor momentary anxiety or depression was associated with more reporting of discriminatory events. This lack of relationship is consistent with research showing that construing as something as discriminatory is a complex psychological process that involves assessing intent, the frequency and distinctiveness of the interaction or event, and consistency with the actor's previous behaviors (Crosby, 1984; McClelland et al., 2016). In fact, people are often likely to minimize discrimination for both reasons relevant to the self and to reduce potential societal costs of making complaints (Crocker & Major, 1989; McClelland et al., 2016). Because of the high cost of identifying something as discriminatory, elevated negative anxiety or depression—while it may have an effect on how negatively an ambiguous interaction is perceived—is not sufficient to label something as discriminatory. Thus, the correlational relationship between negative

mental health and the experience of discrimination reported in many decades of research and meta-analyses (Feldmann-Wüstefeld et al., 2011; Pascoe & Richman, 2009) is likely due to the increase in negative mental health in response to discrimination, rather than the alternative causal relationship.

In addition to examining temporal precedence in the relationship between discrimination and mental health, I examined how individual differences in neurocognitive indices of attention to threat may be important to understanding this relationship. First, I looked at how individual differences in N2pc amplitude were related to anxiety. I did not find evidence that the general N2pc (collapsed across Black and White faces) was related to anxiety either reported during the EMA period or using a well-established measure of trait anxiety. While this may seem surprising given the posited role of attention to threat as an important contributor to the development and maintenance of anxiety (Bar-Haim et al., 2007; Van Bockstaele et al., 2014), there are other studies that also fail to find a relationship between the N2pc elicited by non-face threatening images and self-reported anxiety ($n = 96$; Kappenman et al., 2014) and between the N2pc elicited by unpleasant images and self-reported anxiety ($n = 44$; Grimshaw et al., 2014). These studies tested the between-person correlation between N2pc amplitude and anxiety rather than using a split-groups approach as other studies have done (e.g., Fox et al., 2008).

Additionally, the absence of a significant correlation is perhaps unsurprising, given the small sample size. With the given sample size of 68 for these comparisons, the largest correlation that I have 80% power to detect is $r = .33$. A similar study ($n = 94$) examining the correspondence between the N2pc elicited by angry compared to neutral

faces and different measures of self-reported social anxiety (controlling for general anxiety) reported much smaller correlations, ranging from $r = -.11$ to $-.25$ (Reutter et al., 2017), highlighting the relatively small amount of variance in self-reported anxiety explainable by neurocognitive indices of psychological processes.

However, the N2pc on White trials did correlate significantly with anxiety reported during the EMA period. Combined with evidence that blood-phobic participants show biased attention specific to injuries involving blood (Buodo et al., 2010) and spider-phobic participants show biased attention specific to spiders (Weymar et al., 2013), this suggests that attention is drawn to stimuli as a function of how threatening they are to the participant. For the Black participants in this study, it is possible that angry White faces are seen as more threatening than angry Black faces and thus draw more attention relative to neutral faces. However, biased attention to threatening White faces did not correlate either with the number of race-related events reported during the EMA period nor self-reported past year discrimination, suggesting that someone's experiences with discrimination does not explain why participants may have perceived White faces as more threatening. Additionally, individual differences in N2pc amplitude (both general and outgroup-specific) did not moderate the effect of race-related events on anxiety on the same prompt or the following prompt. In contrast, self-reported vigilance *was* related self-reported past year discrimination, suggesting experiences with discrimination may be important to understanding outgroup-specific vigilance. Thus, there may be too much method-related variance in measuring the N2pc that obscures the between-person relationship between the N2pc and frequency of experiences of discrimination and its moderating effect on anxiety following discrimination, especially given large between-

person differences in ERPs due to physiological variables such as skull thickness that have little psychological relevance (Chauveau et al., 2004; Hagemann et al., 2008).

Another possibility is that the difference in the N2pc measured on Black versus White trials is a function of the specific stimuli used in the dot-probe task rather than outgroup-specific vigilance. In other words, it could be that the angry Black faces were not as angry-looking as the angry White faces, which resulted in biased attention during the White trials. To address this possibility, future research should test outgroup and ingroup vigilance among participants from other racial groups. If White participants display larger N2pcs to pairs of angry/neutral Black faces relative to pairs of angry/neutral White faces, this lends support to the idea that participants are more vigilant when viewing faces of racial outgroups because of more perceived threat from outgroups. However, if White participants display larger N2pcs to pairs of angry/neutral White faces relative to pairs of angry/neutral Black faces, as the Black participants in this study did, this would suggest that this effect is a function of the stimuli themselves, rather than perception of outgroups as more threatening than ingroups.

In addition to the N2pc, I examined an alternative neurocognitive index of attention to threat, the P2 ERP component. Although the P2 has not been specifically implicated in the experience of anxiety, as the N2pc has, it has been extensively researched in the context of social categorization (Ito & Bartholow, 2009) and been linked to White participants' implicit racial bias and endorsement of stereotypes of Black men as violent or dangerous (Correll et al., 2006; He et al., 2009). Additionally, whereas the P2 is generally larger to Black faces than White faces among White participants, two studies have shown the opposite pattern in Black and Asian participants, such that White

faces elicited larger P2s than faces of their racial ingroup (Dickter & Bartholow, 2007; Willadsen-Jensen & Ito, 2008). This cross-over pattern has been interpreted as evidence that P2 amplitude is larger to racial outgroup faces relative to racial ingroup faces because outgroups are more threatening. However, this pattern was not found in the current study. Instead, Black participants exhibited larger P2s to Black faces than White faces, similar to White participants in previous research (Correll et al., 2006; Dickter & Kittel, 2012; He et al., 2009; Ito & Urland, 2003, 2005; Kubota & Ito, 2017, 2007; Volpert-Esmond et al., 2017; Willadsen-Jensen & Ito, 2006, 2015). This pattern was also found in a previous study with Black participants (Volpert-Esmond et al., 2017). Additionally, differentiation in the P2 to Black and White faces was not related to frequency of discrimination, either during the EMA period or self-reported past year discrimination. Thus, it remains unclear what the P2 indexes with regard to racial groups and whether the P2 differentiates to faces as a function of group-related threat. Ongoing research continues to address the functional significance of the P2 for social categorization (Volpert-Esmond & Bartholow, in prep).

However, exploratory analyses showed that differentiation in P2 amplitude to Black and White faces did moderate the effect of reporting a race-related event on anxiety on the subsequent prompt. The interaction was in the direction that one would expect if attention to threat functioned as a risk factor for experiencing anxiety—those with larger $\Delta P2$ values experienced a longer duration of the effect of reporting a race-related event on anxiety, continuing from the current prompt until the subsequent prompt. However, since a larger $\Delta P2$ value refers to larger P2s to Black faces than White faces—opposite to the pattern expected where White faces elicit a larger P2 than Black faces

among Black participants—and because of the exploratory nature of these results, this pattern is difficult to interpret. Future studies should seek to replicate this effect before strong interpretations are made.

Limitations

As with all studies, the current study had limitations. Based on the initial focus groups, I expected a higher rate of reporting of race-related events, especially since I intentionally did not ask participants to report “discrimination”, instead attempting to lower the threshold so that participants would report ambiguous interactions, even if they were not sure if they were discriminatory. However, in the follow up focus groups, some participants reported being unsure on what kinds of events to report and what was within the scope of the study, especially with regard to online interactions. In future research, to address this limitation, I plan to be clearer during the training process and include active participation, including having participants write out examples of the types of interactions they believe would fit within the scope of the study.

Additionally, even when participants clearly understood what they should report, participants in the follow up focus groups revealed that they underreported because a) events happen too often and participant burden is too high to report everything and b) many regularly-occurring events were deemed not significant enough to report. In other words, even though (or perhaps because) a particular type of interaction occurs often, participants have learned to brush that type of interaction off and may not even notice it in the moment, even if upon reflection, they are sure that it is race-related (also see Basford et al., 2014). One possible solution for future research is to shorten the reporting

period to 1 week instead of 4 weeks and increase the frequency of random prompts to allow for more intensive reporting.

Conclusion

The integration of Ecological Momentary Assessment and psychophysiology allowed for the investigation of complex temporal dynamics in the relationship between discrimination and mental health, as well as the role of neurocognitive indices of attention to threat in moderating this relationship. Repeated measurement of affect, anxiety, and depression, as well as real-life experiences with discrimination revealed a complex temporal relationship, such that discrimination had an immediate negative effect, but that after a few hours, this negative effect disappeared and instead increases in positive affect were evident. Neither positive nor negative effects of discrimination persisted until the next day. Additionally, neurocognitive indices did not correspond as expected to frequency of reports of discrimination either during the EMA period or self-reported using a well-established questionnaire. Thus, further research is needed to understand how neurocognitive factors are important in understanding the effect of discrimination on mental health.

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TABLES

Table 1*List of all acronyms used.*

Acronym	Meaning
CBPR	Community-based participatory research
EEG	Electroencephalogram
EMA	Ecological momentary assessment
ERN	Error related negativity
ERPs	Event-related potentials
GAD-7	Generalized Anxiety Disorder questionnaire; assess trait anxiety
MEIM	Multigroup Ethnic Identity Scale
MIBI	Multidimensional Inventory of Black Identity
NA	Negative affect
PA	Positive affect
PHQ-9	Patient Health Questionnaire; assess trait depression
RD	Racial discrimination

Table 2

List of race-related events that participants could select from.

You were unfairly fired or denied a promotion	You were called names or insulted
You were unfairly stopped, searched, or questioned by the police	You were threatened or harassed
You were treated with less courtesy than others	Someone intentionally bumped into you without saying 'Excuse me'
You received less respect than others	Someone incorrectly assumed you were poor
You received poorer service than others in a restaurant or store	Someone incorrectly assumed you grew up in a particular neighborhood
Someone assumed you were not intelligent	Someone said you talk about race too much
Someone acted as if they were better than you	Someone said racism doesn't exist
Someone acted as if they were afraid or threatened by you	Someone mistook you for another black person
Someone incorrectly assumed you were being dishonest	Your opinion or contribution was ignored or overlooked

Note. Participants were not restricted to events on the list.

FIGURES

Figure 1

Trial structure for the dot-probe task.

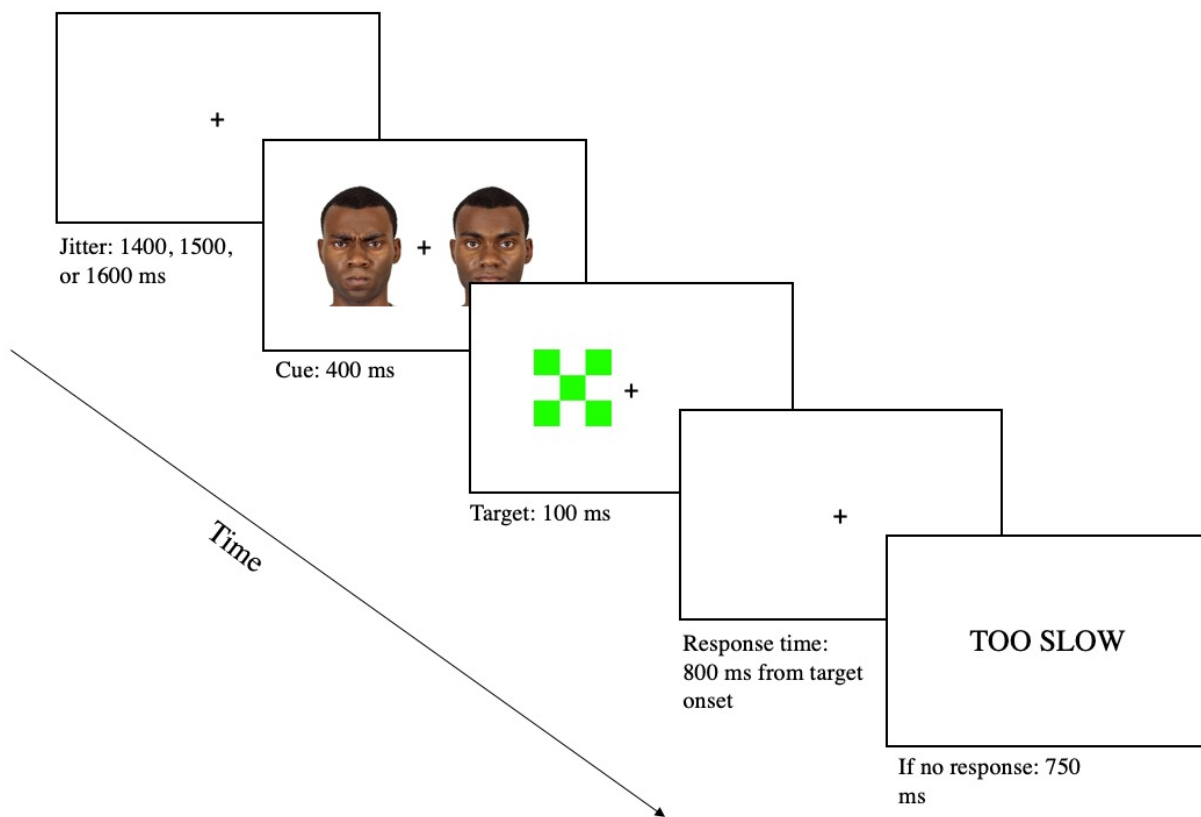


Figure 2

Distribution of the number of race-related events reported by each person over the course of the EMA period.

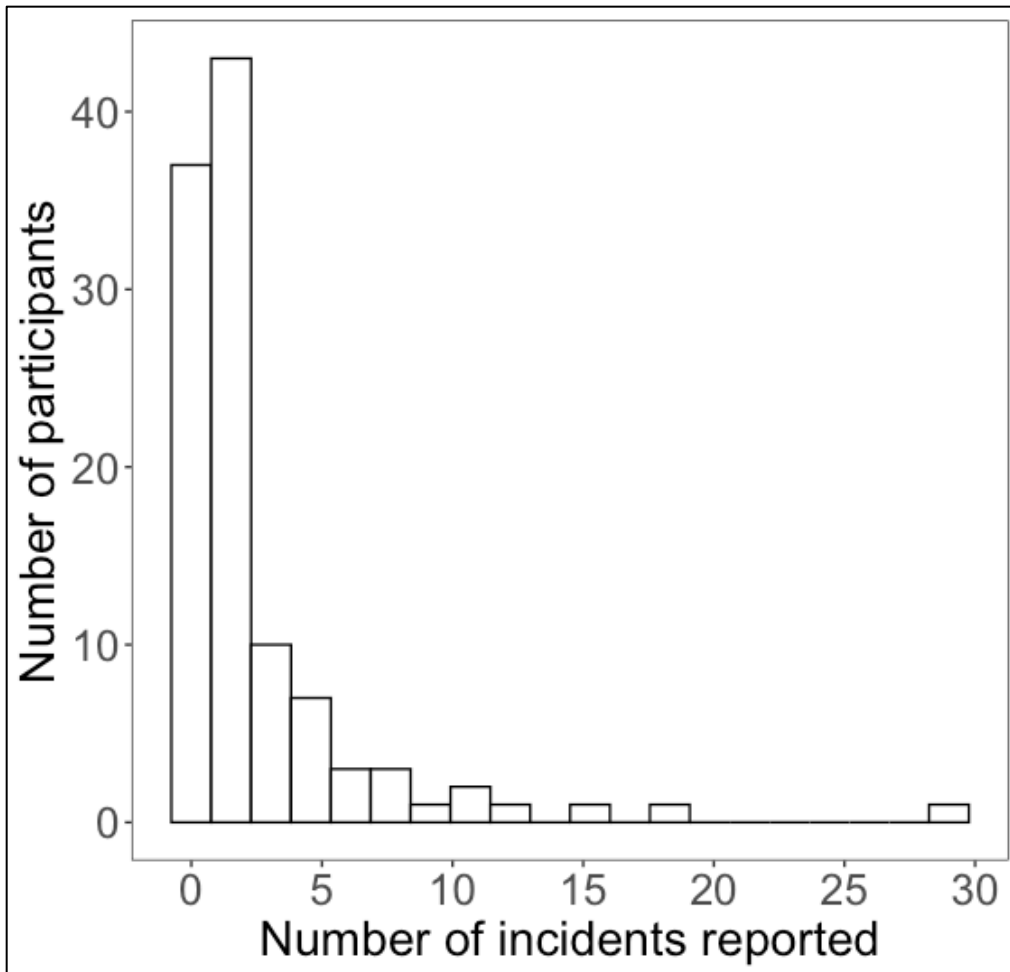


Figure 3

Model predicted means and SEs showing the effect of RD on each dependent variable on any given prompt (Prompt P) and the subsequent prompt (Prompt P+1).

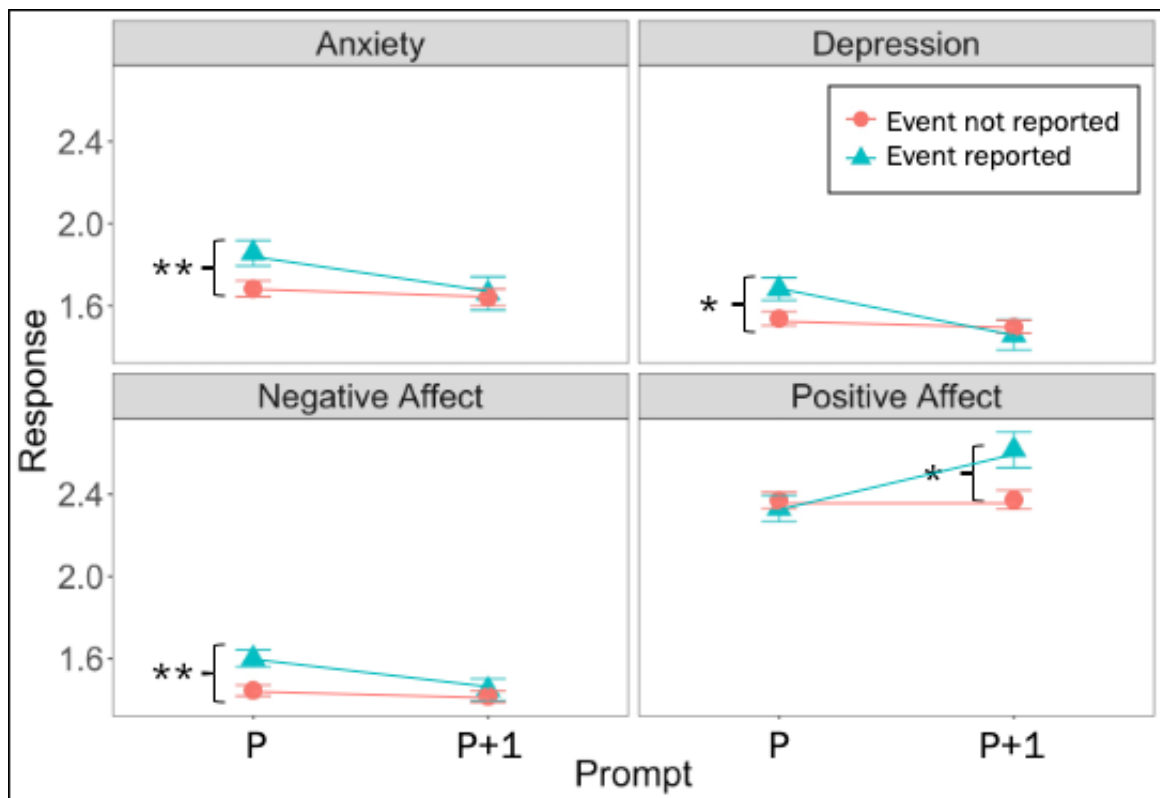


Figure 4

Model predicted means and SEs showing the effect of RD on each dependent variable on any given day (Day D) and the subsequent day (Day D+1).

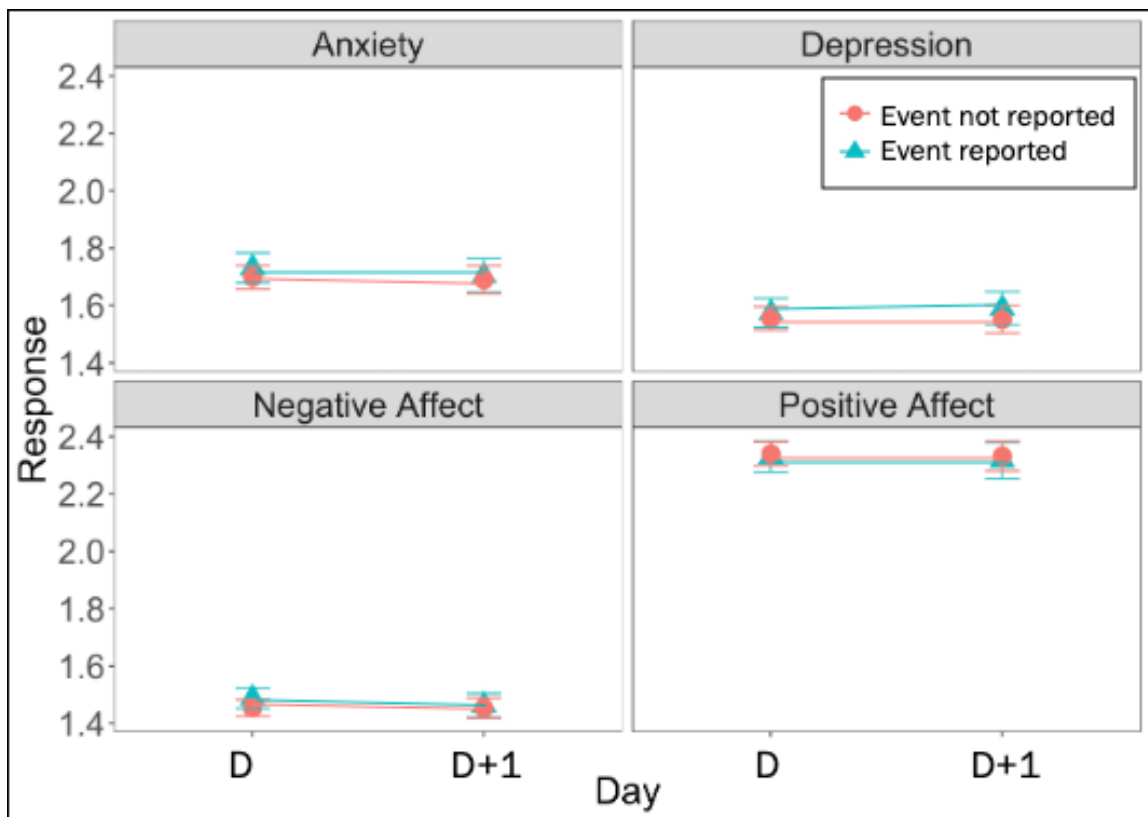
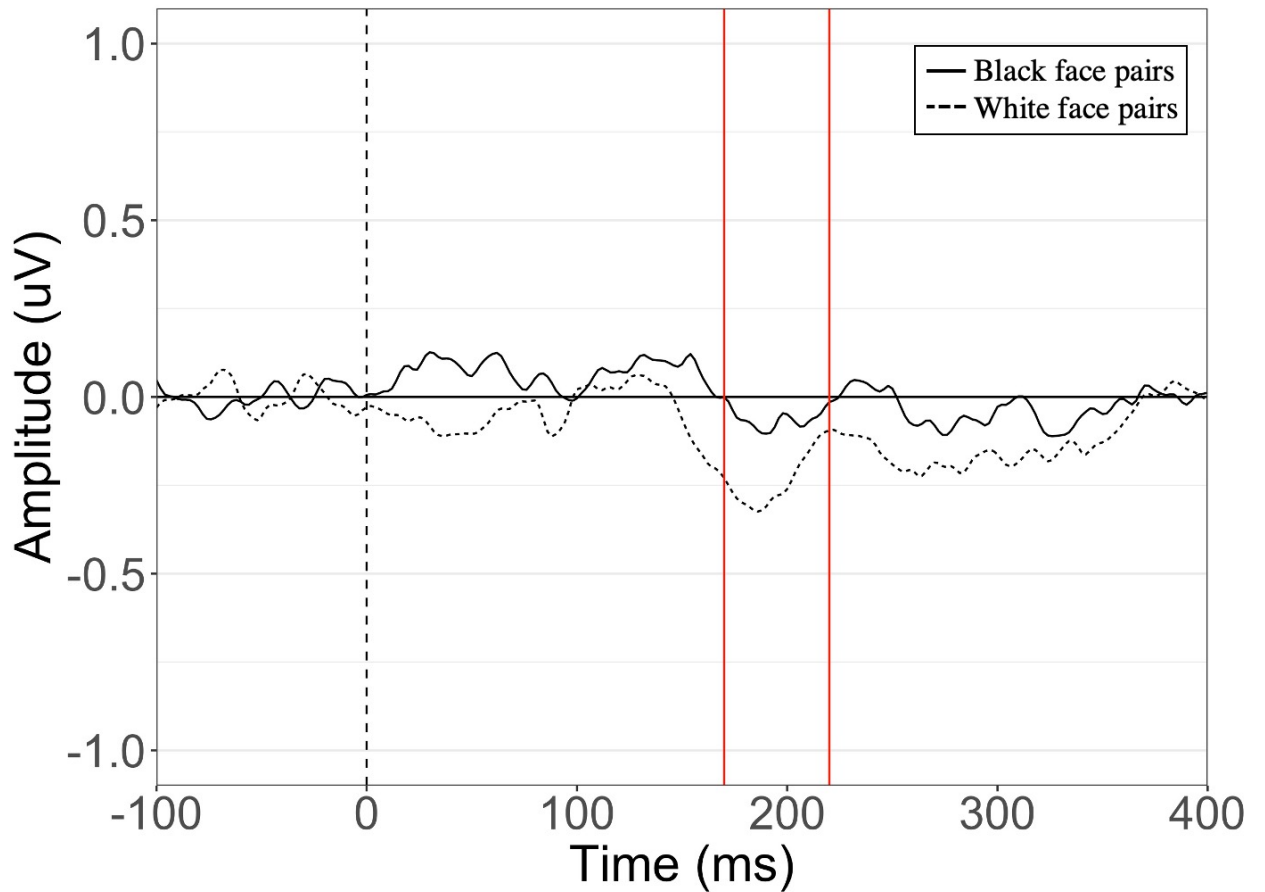


Figure 5

Cue-locked ERP waveforms following the presentation of angry/neutral pairs of Black faces and angry/neutral pairs of White faces in the dot-probe task.



Note. N2pc amplitude was quantified between 170-220 ms post-cue-onset, which is indicated by the red lines.

Figure 6

Correlation between N2pc amplitude elicited in White trials and aggregate anxiety reported during the EMA period.

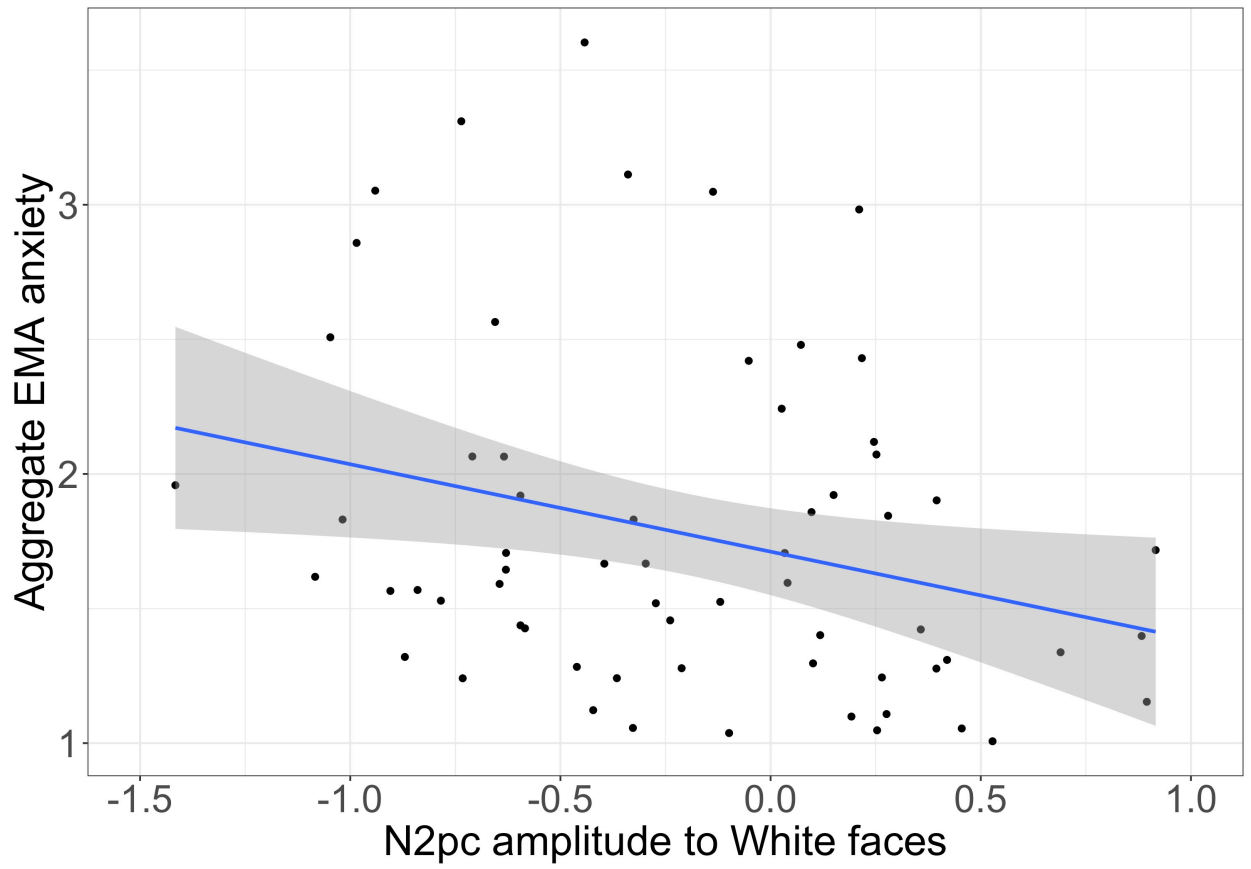
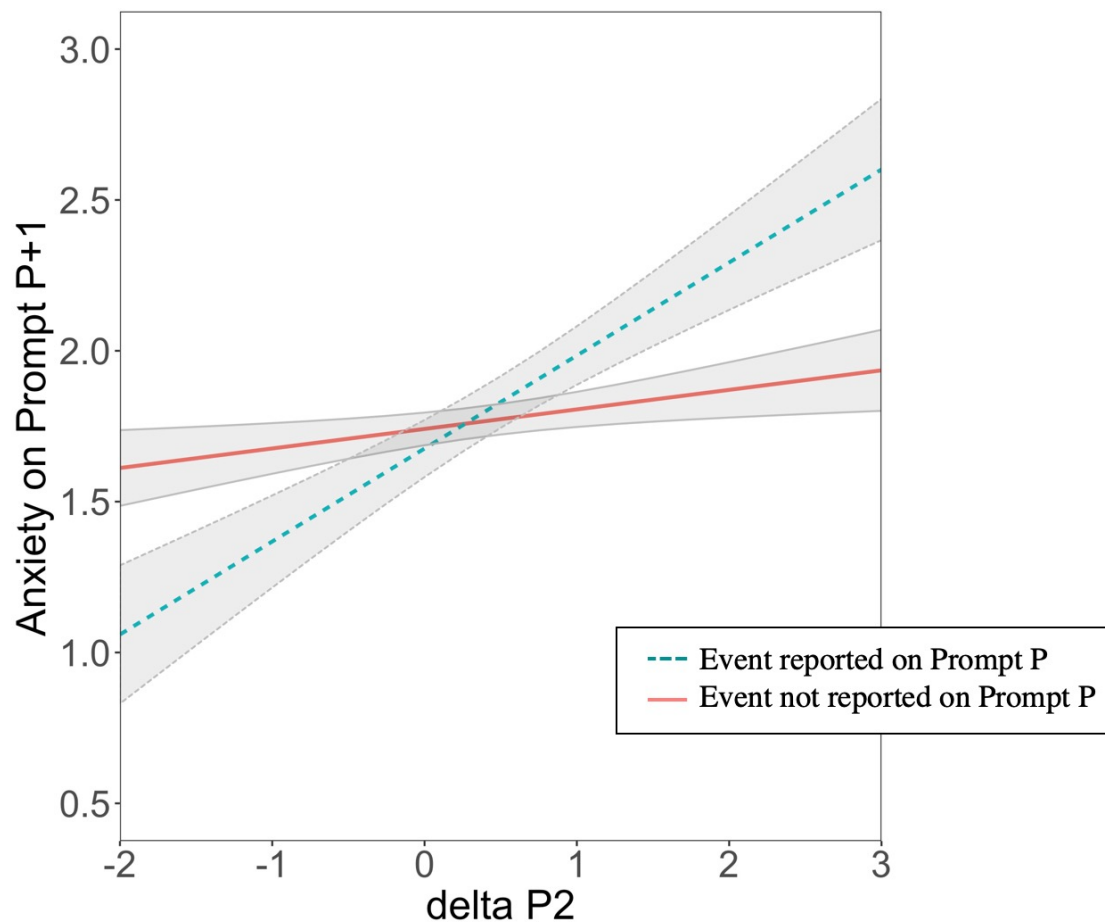


Figure 7

Moderation of the effect of reporting a race-related event on anxiety reported on the subsequent prompt by $\Delta P2$.



Note. Shaded area indicates standard error of estimate.

VITA

Hannah Volpert-Esmond was raised in Wayne, Pennsylvania by her mother, Heewon Chang, and her father, Klaus Volpert, with her brother, Peter Volpert, who is two years younger than she. Both of her parents are first generation immigrants from South Korea and Germany, respectively. She attended Radnor High School and took a gap year before starting her undergraduate training at the University of Delaware. She received her Bachelor of Science degree in 2012, double-majoring in Psychology and Neuroscience. Following graduation, she moved to Columbia, Missouri, and worked as a lab manager for two years in the Social Cognitive and Affective Neuroscience lab of Dr. Bruce Bartholow at the University of Missouri. She entered the Ph.D. program in Psychology at the University of Missouri in 2014, completing her MA in 2016. She was married to Bryan Esmond in 2016.