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Psychophysiological and affective reactivity to vicarious police violence

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Abstract

Little is known about how vicarious police violence, or instances of police violence observed but not directly experienced, impacts health among Black individuals. Using a lab-based paradigm in a sample of young adults ($N = 101$), this study examined: (a) psychophysiological reactivity to instances of vicarious police violence, particularly the assault and shooting of Black individuals; (b) affective reactivity to instances of vicarious police violence; and (c) how racial identity, one important moderator, influences psychophysiological and affective responses to vicarious police violence. Using electrocardiography and impedance cardiography, participants' cardiac sympathetic and parasympathetic physiological responses were continuously monitored. Three sets of high-quality color photographs (neutral, non-violent distress, violence) were viewed on a computer. Participants rated their affect after each set using the Positive and Negative Affect Schedule (PANAS). Following this task, racial identity was assessed using the Multidimensional Inventory of Black Identity-Short Form. Findings indicated that vicarious police violence was associated with greater sympathetic reactivity and negative affect relative to the neutral and non-violent distress conditions. Additionally, higher levels of racial centrality exacerbated the association between vicarious police violence and negative affect. Findings suggest that Black individuals may wish to limit their consumption of media depicting the assault and shooting of other Black individuals, with the caveat that the best solution is ultimately the cessation of police violence.

KEYWORDS

affect, electrocardiography, police, racial identity, racism, vicarious

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> "I can't breathe."

–Eric Garner and George Floyd, prior to being murdered by police officers.

> "I'm struggling right now from the stress of everything because the system, it beats you down."

–Erica Garner, daughter of Eric Garner, 1 month before dying from a heart attack at age 27

> "Her heart was attacked by a system that would choke her dad and not hold accountable those that did it."

–Reverend Al Sharpton, lamenting Erica Garner's death

1 | INTRODUCTION

Police violence is one of the leading causes of death for young men of color, and officers are 3.5 times more likely to kill Black[1] individuals relative to their white counterparts (Edwards et al., 2019). Latina and Black women experience higher levels of physical, sexual, and psychological police violence and neglect relative to white women (Fedina et al., 2018). In 2020, though Black individuals were more likely to be unarmed, they were more likely to be killed by police officers relative to those from other racial and/or ethnic groups (Mapping Police Violence, 2020). An abundance of media attention has, understandably, centered on high-profile murders. While death is the severest outcome, it is not the most common, and population-level effects are also crucial to examine and document (DeVylder et al., 2020). Viewing police violence toward Black children and adults has become unsettlingly commonplace and can be conceptualized as *vicarious police violence*. We define vicarious police violence as witnessing or hearing about violence perpetrated by police officers via family, community, social networks, or media outlets (Simckes et al., 2021). The current study investigated physiological and affective responses to vicarious police violence, and how racial identity (i.e., the significance and meaning attributed to racial membership; Sellers et al., 1998) influences these associations.

The conceptual terrain of police violence[2] continues to be developed but appears to fall within two broader concepts: violence and racism. Some public health researchers have mapped police violence onto the domains of violence (physical, sexual, psychological, neglectful) set forth by the World Health Organization (WHO; H. Cooper et al., 2004; Krug et al., 2002). However, some work asserts that police violence is theoretically distinct from other forms of violence due to its robust mental health outcomes (DeVylder et al., 2020). One proposed factor that may make it unique includes racial disparities in exposure (DeVylder et al., 2020).

Jones (2000) conceptualized racial discrimination as occurring at three distinct levels (also see J. M. Jones, 1997): *internalized* (acceptance of negative messages about abilities and worth), *personally mediated* (intentional and unintentional prejudice and discrimination), and *institutionalized* (differential access to goods, services, and opportunities). While Jones (2000) includes police brutality under *personally mediated* racism, it can arguably also be included under *institutionalized* racism wherein institutions may implicitly or explicitly perpetuate racist attitudes and discriminative practices through training procedures, formal or informal guidelines, and local culture. Indeed, theory and research indicate that structural racism is a predictor of police violence (Carbado, 2015; Mesic et al., 2018; Ross, 2015) and Black individuals are disproportionally stopped, searched, and arrested (Epp et al., 2014; Gaston, 2019; Jones-Brown et al., 2013). Police shootings have been described as modern-day lynching (Embrick, 2015; Karabel, 2015) and this violence cannot be divorced from the United States' history of racist slave patrols, the Black Codes, and lynching—"the police are to the state as an edge is to a knife" (Bayley, 1990; Equal Justice Initiative, 2017; Jacobs & O'Brien, 1998, p. 859). While some cast police violence as having nothing to do with race, studies indicate that Black individuals are shot more rapidly and frequently than white individuals (e.g., Correll

[1]Throughout this paper, the term "Black" refers to people with total or partial ancestry that can be traced to the continent of Africa regardless of the place of birth (e.g., African Americans, African or Caribbean emigrants).

[2]Other terms used in the reviewed literature, which appear to have some overlap in their definitions, include police encounters, police interactions, police contact, police exposure, police surveillance, police stops, police brutality, police harassment, police shootings, police conflict, police executions, undue police violence, police racial violence, blue-on-black violence, racial or ethnic cultural cataclysmic events, racially motivated police brutality trauma, vicarious discrimination, and excessive use of force. *Police violence* is used in this article as the authors consider it to be the most encompassing term to capture the range of force used by officers. Importantly, it does not judge intention or distinguish between "justifiable" and excessive force. The term *police brutality* was also considered in an effort to capture the dehumanizing nature of police action; however, this term may exclude harm that occurs regardless of intent (Bandes, 1999) and low levels of force that cause harm (e.g., stops and searches; Green & Evans, 2021).

et al., 2002), and that stereotypic associations influence visual processing (Eberhardt et al., 2004)—suggesting that nonconscious processes can lead to errors that influence behavior (e.g., associating Black individuals with criminality; dehumanization; Richardson & Goff, 2012).

Police violence (including stops, searches, exposure to police killings, interactions with the court system) has been associated with a twofold higher prevalence of poor mental health outcomes (e.g., psychotic experiences, depression, posttraumatic stress disorder [PTSD], anxiety) for those who experienced a prior police interaction relative to those who did not (for a review, see McLeod et al., 2020). The mere anticipation of police interactions elicits fear in Black boys (Staggers-Hakim, 2016). Racist incidents have been conceptualized as trauma (i.e., race-based traumatic stress), likened to domestic violence and rape, and found to be significantly related to PTSD symptoms (Bryant-Davis & Ocampo, 2005; Carter, 2007; Carter et al., 2019).

Research investigating the health impact on Black community members who witness, or are in close proximity to, police violence and resultant civil unrest has found increases in mental health symptoms (Galovski et al., 2016; Yimgang et al., 2017). One study examined the impact of exposure to community violence on mental health during the August 2014 Ferguson, Missouri protests following the murder of Michael Brown (Galovski et al., 2016). Exposure was defined as living or working within 30 miles of Ferguson. Results indicated that Black community members (72% of sample) reported higher levels of depression and PTSD symptoms than white community members. Another study examined changes in maternal-child health following the April 2015 civil unrest in Baltimore, Maryland after the murder of Freddie Gray (Yimgang et al., 2017). Maternal depressive symptoms among Black women (93% of sample) significantly increased in proximal (i.e., zip codes identified as sites of civil unrest), but not distal, neighborhoods. Police violence can also influence community members' behavior. One study found that following the brutal beating of Frank Jude, residents of Milwaukee, Wisconsin—especially Black residents—were less likely to call the police (Desmond et al., 2016). Additionally, it took longer for citizen crime reporting to return to normal levels in Black neighborhoods relative to white neighborhoods.

Few studies have examined the impact of these events on individuals farther away from the scene (i.e., vicarious police violence). However, one study examined the mental health spillover effect of police killings in a national, population-representative sample using a telephone-based, random digit dial survey (Bor et al., 2018). Findings revealed that exposure to police killings of unarmed Black individuals, defined as living in the state where the killing occurred, was associated with worse mental health among Black, but not white, Americans. Results did not indicate any significant effects for police killings of armed Black individuals or unarmed white individuals. The absence of cross-race effects suggests that police violence has uniquely corrosive sequelae for Black individuals. Qualitative research using phenomenological interviews indicates that Black individuals report a fear of dying, hypervigilance, and difficulty coping secondary to viewing graphic images of police brutality (Hawkins, 2021). Additionally, the mental health burden of these killings contributed to 55 million excess poor mental health days (i.e., number of days mental health reported as "not good" in the past month) per year among Black adults, which is comparable to the mental health burden associated with diabetes.

Two unpublished studies, a thesis and dissertation, used experimental paradigms to capture the real-time impact of witnessing police violence on biological outcomes (Kort, 2016; Trujillo, 2018). Of note, these studies conceptualized witnessing police violence as *vicarious discrimination*. Kort (2016) examined the impact of witnessing police violence on the cardiovascular reactivity of Black (44%) and white (56%) participants. Participants were randomly assigned to one of two conditions: police brutality or an automobile accident (control). In each condition, participants viewed five slides that presented a date, location, details of an event, and images. Participants then engaged in a speech task during which they described their reactions to the slides they viewed while being video- and audiotaped. Findings indicated that overall, participants demonstrated increased reactivity in heart rate, pre-ejection period, systolic blood pressure, and respiratory sinus arrhythmia to the police brutality condition relative to the automobile accident condition. However, a small to medium effect for systolic blood pressure and affective reactivity was stronger among Black participants. Given that many autonomic nervous system patterns are believed to index psychological states stemming from active (e.g., making a speech) rather than passive (e.g., viewing images or videos) tasks (Mendes, 2009), the nuances of study design may have yielded unique responses.

Trujillo (2018) examined whether there were racial differences in stress responses between Black (44%) and white (51.7%) participants who viewed a video of police fatally wounding an unarmed Black man. This study investigated whether responses were predicted by stigma-related stressors, associated with risk-taking, and moderated by ethnic identity and distress tolerance. Contrary to hypotheses, a medium to large effect for galvanic skin response was stronger among white participants relative to Black

participants, and there were no significant racial differences in heart rate variability, systolic blood pressure, or facial electromyography. The author suggested that Black individuals might have habituated to such videos whereas white individuals, who may be less aware or have less exposure to such videos, perceived them as novel.

It is unclear whether racial differences in galvanic skin response were due to the experimental manipulation or because Black participants exhibit lower galvanic skin response than white participants (Alexandra Kredlow et al., 2017; Johnson & Landon, 1965; Lieblich et al., 1973). Additionally, ethnic identity did not emerge as a significant moderator. The author acknowledged that using a measure that tapped into more Afrocentric values, as opposed to one validated on different ethnic groups, might have captured more culturally-specific factors related to ethnic identity and could explain why racial identity did not emerge as a moderator. A methodological critique of the use of race in psychology asserted that while race is frequently used in psychological science "as if it has an obvious meaning," racial categories are conceptually void (Helms et al., 2005, p. 27). Thus, the use of a within-group design would better allow for the use of culturally-validated measures (e.g., Multidimensional Inventory of Black Identity; Martin et al., 2010) and the examination of potentially culturally-specific mechanisms (e.g., racial identity; Jones & Neblett, 2017; Neblett et al., 2012).

Nonetheless, a shared strength of these studies was their focus on physiological reactivity. Psychophysiological methods are particularly valuable tools within Black psychology and have been increasingly used to explore the associations between perceived discrimination and health (e.g., D. C. Cooper et al., 2014; Harrell et al., 2004; Hoggard et al., 2015; Wagner et al., 2015). Examining autonomic nervous system and cardiovascular reactivity to vicarious police violence may help us understand the high burden of cardiovascular disease and related cardiometabolic illnesses among Black individuals in America, as one mechanism underlying racial disparities in health may be the physiological dysregulation that occurs after exposure to stressors (Assari, 2018; Crimmins et al., 2007; Richman & Jonassaint, 2008). Much of the existing work examining race-related experiences of Black individuals has centered on racial discrimination and typically uses blood pressure as an index of cardiovascular activity. However, blood pressure provides only a partial view of how perceived discrimination impacts health (Hill et al., 2017). Some researchers suggest that it is important to take the simultaneous activity of *both* the sympathetic (SNS) and parasympathetic nervous systems into account (PNS; Berntson et al., 1994). To assess the potentially parallel versus divergent relations of SNS and PNS activity with vicarious police violence, we collected continuous electrocardiography and impedance cardiography measures in order to derive pre-ejection period (PEP), an index of SNS cardiac influence, alongside respiratory sinus arrhythmia (RSA), an index of PNS cardiac influence. We also examined heart rate (HR) as a more general, clinically relevant autonomic and cardiovascular index, with the goal of providing secondary insights into potential SNS and PNS interplay.

In addition to psychophysiological responses, responses to vicarious police violence may manifest through affect. Longstanding work in health psychology and epidemiology supports the notion that negative affect can potentiate greater susceptibility to infections, such as the common cold, while also being associated with higher risk for cardiovascular and metabolic diseases and a shorter lifespan (e.g., Carnethon et al., 2003). In contrast, positive affect can offer health-protective qualities, including lower disease risk factors such as atherosclerosis, lower incidence of diseases such as coronary heart disease, and lower mortality rates (Giannelou et al., 2018; Jokela et al., 2014; Pressman & Cohen, 2005). Thus, combining psychophysiological and affective self-report methods enables us to take a multi-pronged approach to concurrent reactivity processes while adding to broader perspectives on the role of discrimination as one chronic pathway to health disparities (Cyders & Coskunpinar, 2011).

Notably, the existing vicarious (and perceived discrimination) literature points to the potential importance of racial identity as a moderator of the link between vicarious police violence and psychophysiological and affective reactivity (e.g., Volpe et al., 2018). Racial identity is defined as the significance and qualitative meaning that individuals attribute to their racial membership (Sellers et al., 1998). Researchers have recommended that scholars examine how racial identity shapes experiences with vicarious racism as it may influence how people of color experience and respond to racism (Mason et al., 2017). The Multidimensional Model of Racial Identity (MMRI) conceptualizes racial identity as having four dimensions: salience, centrality, ideology, and regard (Sellers et al., 1998). There is ample and consistent empirical evidence to suggest that racial centrality and regard play an important role in physiological and affective sequelae of racial discrimination (e.g., Neblett & Roberts, 2013; Rucker et al., 2014). *Racial regard* is the degree to which individuals feel positively or negatively about their race. There are two components: private and public regard. *Private regard* is the degree to which one feels positively or negatively toward African Americans as well as about being African American. *Public regard* is the degree to which one believes others view African Americans

positively or negatively. *Racial centrality* is the degree to which individuals normatively define themselves with regard to race across situations. Overall, studies suggest that racial identity may operate in a nuanced fashion. An abundance of research has highlighted the *protective* role of racial identity (e.g., Neblett & Carter, 2012), but some work suggests that certain dimensions of racial identity, such as racial centrality, may also serve as a *vulnerability* factor (Rucker et al., 2014; Willis & Neblett, 2018). For example, one study found that those with high centrality and low public regard demonstrated more negative affect in response to hearing details from the George Zimmerman trial (Mason et al., 2017).

The aforementioned interplay of vicarious police violence, psychophysiology, affect, and racial identity shows promise, but several limitations need to be addressed. First, little research has examined vicarious police violence even though the rise of citizen journalism (Goode, 2009), which includes photo and video sharing, has radically increased exposure to such events and images. Second, a majority of studies examining vicarious police violence rely on self-report data and/or questionnaires. Lab-based stress and emotion inductions are a rich, underutilized method that can enable researchers to capture responses to vicarious police violence in situ—as it is lived—rather than relying on self-reports of behavior (Shiffman et al., 2008). Pioneered in the 80s, pictures, films, and imagery have long been used to capture physiological and affective responses (Gross & Levenson, 1995; Lang et al., 1988; Sutherland & Harrell, 1986). Most studies have examined predominantly SNS-mediated stress responses in the context of race-related stress, but growing evidence supports the modulating role of the PNS in a range of diseases (Thayer & Friedman, 2004). Third, it is crucial to identify which factors may protect individuals from, or render them more vulnerable to, physiological responses to vicarious police violence. In light of these limitations in the prior literature, the present study sought to understand how: (1) Black individuals respond physiologically to instances of vicarious police violence; (2) Black individuals respond affectively to instances of vicarious police; and (3) racial identity may moderate responses to vicarious police violence.

Consistent with findings of studies examining physiological responses to perceived discrimination (e.g., Hoggard et al., 2015), we hypothesized that viewing high-quality color photographs depicting police violence (i.e., assault, shooting) against Black individuals would upregulate physiological responses. We expected this response to induce stronger experiences of vicarious police violence relative to non-violent distress or neutral photographs given that participants' shared racial phenotype with the individuals depicted in the photographs might prompt them to imagine themselves in the place of the targets and experience stress responses (Truong et al., 2016). Consistent with previous research suggesting that anger and feeling disrespected are common responses to discrimination (Broudy et al., 2007; Carter & Forsyth, 2010), we expected that vicarious police violence would elicit greater self-reported negative affect and lower positive affect relative to a non-violent distress or neutral stressor. Exposure to these photographs might lead participants to contend with the reality that they live in a world that systematically devalues and marginalizes their racial group, yielding negative mood (Heard-Garris et al., 2017). In line with deductions that feeling positively about their race may lead individuals to see situations as personal affronts (Sellers et al., 2001) and findings that low centrality mitigated acute physiological responses (Volpe et al., 2018), we expected that those with low private regard and centrality would demonstrate greater sympathetic inhibition and parasympathetic augmentation than those with moderate or high levels, indicating a protective effect. Similarly, we anticipated that these individuals with low regard and centrality would not demonstrate significant shifts in affect when viewing vicarious police violence photographs. We also hypothesized that those with low and high levels of public regard would demonstrate greater sympathetic activation and parasympathetic withdrawal, evidencing greater physiological recruitment consistent with a psychological stressor, than those with moderate levels (Neblett & Roberts, 2013). Further, they would also demonstrate higher levels of negative affect and lower levels of positive affect.

2 | METHOD

2.1 | Participants

An a priori power analysis using G Power 3.1.9.2 (Faul et al., 2007) indicated that a total sample size of 100 participants would be needed to detect small effects with 80% power using repeated measures analysis of variance (ANOVA; within factors) with alpha at .05. Thus, we recruited 101 healthy young adults who self-identified as Black and were attending a public, predominantly white university and/or residing in the southeastern United States. Self-reported family socioeconomic status (SES) included: 4% poor, 33.7% working class, 46.5% middle class, and 15.8% upper-middle class. The sample consisted of 56 females (55.4%) and

45 males (44.6%) with an average age of 23.69 years (SD = 3.62; range = 18–30). This particular age bracket was selected as it falls within the developmental period of emerging adulthood—a period that lies between adolescence and young adulthood (Arnett, 2000). In addition to managing their new independence during a developmental period associated with elevated mood disorders and peak substance use, Black emerging adults are vulnerable to minoritized status stressors (e.g., discrimination) that are associated with increased psychological distress and alcohol use over time (Hurd et al., 2014). To increase the generalizability of findings across a diversity of emerging Black young adult experiences, we recruited a balanced sample of undergraduate students (34%), graduate students (35%), and community members (31%).[3]

This study was approved by the Institutional Review Board (IRB #17–2562). Participants were recruited using a variety of means including a university website designed to recruit study volunteers, fliers, and email. Consistent with field recommendations (Laborde et al., 2017), participants were excluded if they endorsed: a current diagnosis of any chronic, cardiovascular, auto-immune, renal, or other somatic illness; usage of medications or devices that alter cardiovascular function; or usage of long-term prescription medications, excluding birth control. Participants were also excluded if they participated in a prior study that validated the photographs used.

2.2 | Materials

Materials comprised 36 high-quality color photographs[4] that were validated in a previous study (IRB #18–0865)[5] using procedures widely employed in major picture databases (e.g., Betella & Verschure, 2016). Three conditions or blocks of 12 photographs were presented. The *neutral* condition consisted of photographs depicting ordinary scenes such as Black people boxing. The *non-violent distress* condition consisted of photographs depicting unpleasant scenes such as a starving Black child or a homeless Black man. The *violence* condition consisted of photographs depicting the assault or shooting of Black individuals by police officers.

2.3 | Procedure

Prior to the lab session, the investigator described the study to participants via phone and determined their eligibility. Participants were told they would view a series of "media images" during the study. No detail about the content of the photographs was provided. Upon arrival at the lab session, informed consent and measures of waist circumference, height, and weight were obtained. The principal investigator and research assistant who interacted with participants identified as African/Black American and Mexican /Black American cisgender women, respectively. Participants were outfitted with seven spot electrodes for continuous physiological assessment. Participants

[3]We recruited these different groups to improve our sample diversity representing Black healthy young adults, without any a priori expectations about potential group differences. However, readers may wonder if physiological and affective reactivity during vicarious police violence (vs. other conditions in the study) might have differed between these groups. We conducted supplementary analyses using within-between repeated measures ANOVAs wherein *group* was the between-subjects factor (undergraduate, graduate, community) and *condition* (baseline, neutral, non-violent distress, violence) was the within-subjects factor. Interestingly, there were no significant between-group effects nor interactions between *group* × *condition* on physiological reactivity (pre-ejection period, respiratory sinus arrhythmia, heart rate) nor affective reactivity (negative affect, positive affect), even when adjusting for age, self-reported gender, and family SES. This suggests that, at least in the present sample, physiological and affective responses were similar across sampled groups. Similarly, one-way ANOVAs revealed no significant differences between the three sample groups on racial identity measures of private regard, public regard, or centrality. Future studies should seek to replicate findings with larger samples of each group (e.g., students vs. age-matched community samples) or to more explicitly recruit on the basis of sample differences (e.g., high vs. low educational attainment, high vs. low SES).

[4]Photograph resolution was 150 pixels-per-inch (ppi). The photograph size range was 740–1500 (width) and 663–1125 (height).

[5]Participants were 100 Black individuals in the stimulus validation study. The sample consisted of 31 females (49.2%) and 69 males (50.8%) with an average age of 25.43 years (SD = 2.80; range = 19–30). Participants were recruited via the online platform Amazon Mechanical Turk—a tool used to obtain high-quality data inexpensively and rapidly (Buhrmester et al., 2011). Using an affective slider (Betella & Verschure, 2016) photographs were rated on valence which ranged from 1 (Unhappy) to 9 (Happy), and arousal, which ranged from 1 (Calm) to 9 (Activated). Photographs were obtained from sources such as the International Affective Picture System (IAPS; Lang et al., 1997), Nencki Affective Picture System (NAPS; Marchewka et al., 2014), Geneva Affective Picture Database (GAPED; Dan-Glauser & Scherer, 2011), Open Affective Standardized Image Set (OASIS; Kurdi et al., 2017), and the Internet. Photographs were randomized using a PowerPoint macro. A subset of photographs was selected based on each image's mean and standard deviation to create the neutral, non-violent distress, and violence conditions. A one-way repeated measures ANOVA was conducted to determine whether there were statistically significant differences in ratings across neutral, non-violent distress, and violence conditions. There were significant differences in both valence and arousal among each of the three conditions, with ratings increasing across neutral, non-violent distress, and violence categories, respectively.

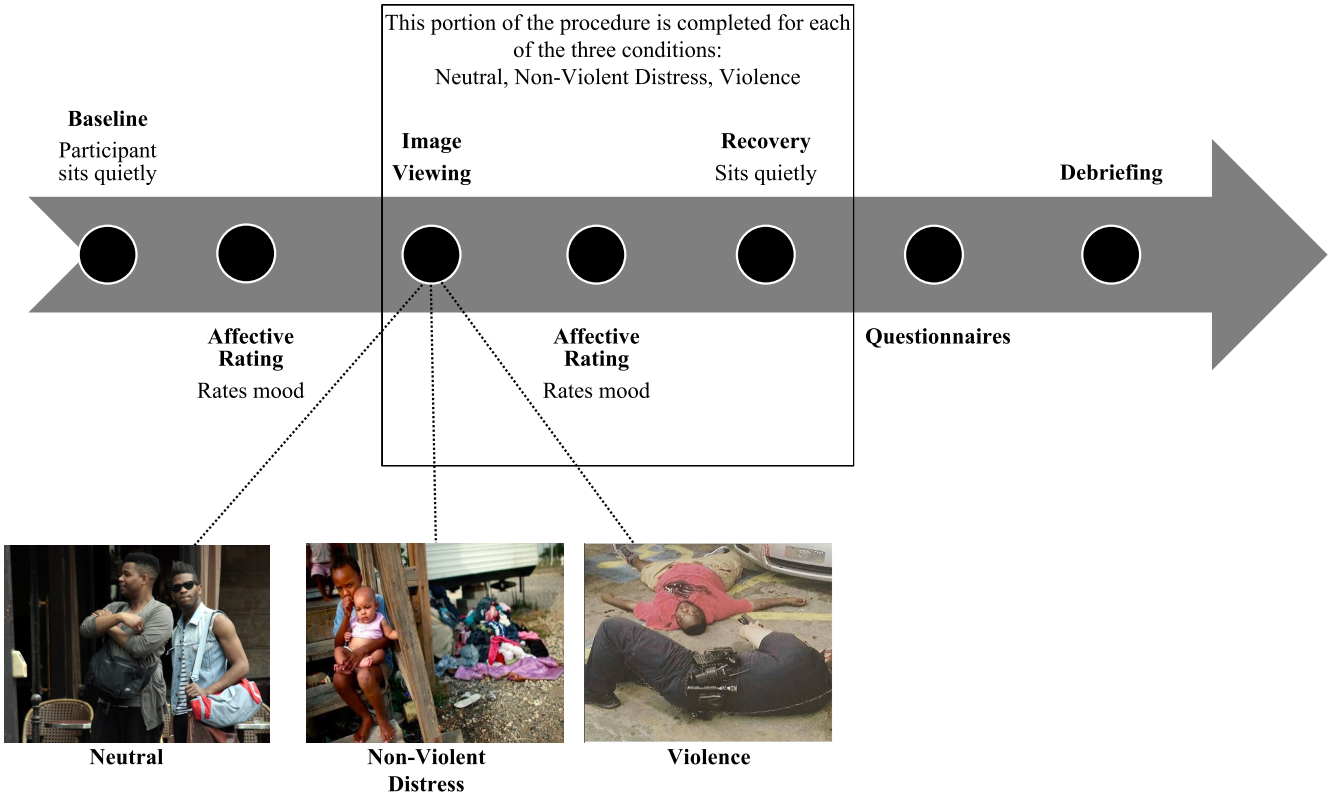

FIGURE 1 Study procedure and sample photographs

were seated in a separate chamber (with the door shut, 10–15 feet away) from the researchers and were asked to leave their belongings outside the chamber. Researchers were able to monitor participants' progression through the study by viewing the mirror image of participants' computers on a computer station outside the chamber. Participants were not directly observed during the experiment and were able to easily communicate with researchers during the study if necessary. Participants relaxed for a 5-min rest period (baseline). Next, participants rated their baseline, pre-task affect.

Participants were instructed to view three blocks of photographs (corresponding to the conditions of neutral, non-violent distress, and violence) that were designed, randomized, and administered via EPrime (Figure 1). We randomized both *within-condition* (all photographs within a block) and *between-condition* (the order of blocks, i.e., conditions). We randomized at both of these levels of photographs and conditions in order to reduce the confounding of physiological and affective responding with order effects. Consistent with recommendations that a period of at least 1 min is necessary to obtain reliable physiological estimates (Berntson et al., 1997), participants viewed each condition of this computer task for 3 min. Each condition/block contained 12 photographs that were presented only once, with each photograph presented for 15 s before advancing to the next photograph. After each condition, participants rated their post-task affect. Next, participants completed a 5-min recovery period during which they were told to relax (Neblett & Roberts, 2013), with the goal of minimizing the transference of physiological and/or psychological responses from one block to another. Participants completed three iterations of this procedure (condition presentation, affect rating, seated resting recovery). Spot electrodes were removed at the end of the computer task. Following the computer task, participants completed questionnaires using Qualtrics. Participants were debriefed and compensated $20.

2.4 | Measures

2.4.1 | Demographics

Participants completed a questionnaire that assessed age, gender, race/ethnicity, socioeconomic status, and educational status.

2.4.2 | Racial identity

The Multidimensional Inventory of Black Identity-Short Form (MIBI-S; Martin et al., 2010) was administered to assess two of the four dimensions proposed by the MMRI (i.e., centrality, regard). These dimensions were included as they are more stable than other dimensions (e.g.,

salience) that are situational and context-dependent (i.e., likely to be influenced by experimental manipulation; Sellers et al., 1997, 1998; Tang et al., 2016) and they are empirically supported predictors of racial identity outcomes. Instructions asked participants to indicate the degree to which they identified with 20 statements. Cronbach's alpha coefficients were computed for the present sample. Responses were rated from 1 = *strongly disagree* to 7 = *strongly agree*, with higher scores indicating more positive feelings toward Black individuals as well as being Black (private regard; α = .75), greater belief that others view Black individuals positively (public regard; α = .70), or greater endorsement of race as important to one's identity (racial centrality; α = .81). Confirmatory factor analyses support the construct validity for the MIBI–S (Martin et al., 2010).

2.4.3 | Affect

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was completed immediately following exposure to each condition. This 20-item self-report measure instructed participants to indicate the extent to which they felt a variety of emotions from 1 = *very slightly or not at* all to 5 = *extremely*. The PANAS yields both a positive and negative affect score, with higher scores on the former indicating higher levels of positive affect and lower scores on the latter indicating lower levels of negative affect. Cronbach's alpha coefficients were computed for the present sample (αs = .81–.88). The PANAS is widely used in the field of emotion research and has a valid, reliable psychometric profile (Watson et al., 1988).

2.5 | Apparatus and physiological measures

Psychophysiology data were acquired using electrocardiography (ECG) and impedance cardiography (ICG) signals. ECG and ICG recordings were obtained using MindWare Technologies' (Gahanna, OH, USA) Bionex chassis and BioLab Acquisition Software at a sampling rate of 1000 Hz. ECG recordings were obtained using three spot electrodes placed on the right collarbone (−) and lowermost ribs (+ and ground). ICG recordings were obtained using a four-spot electrode array (Sherwood et al., 1990), with two electrodes on the front torso at the top (+) and bottom (−) of the sternum and two more electrodes on the upper spine (+) and lower spine (−). ICG electrode distances were measured (inches) between the two front electrodes and between the two back electrodes to ensure correct placement and for use in ICG scoring.

We used Mindware's *Heart Rate Variability Analysis* software (v. 3.1.5) to score ECG data, with respiration imputed from ICG. The high-frequency band for heart rate variability was set between .12 and .42, the low-frequency band was between .04 and .12, and the very low-frequency band was between .003 and .04. Similarly, we used Mindware's *Impedance Analysis* software (v. 3.1.2) to score ICG data, using Biolab's default filter for the first derivative of basal thoracic impedance (dZ/dt). To obtain initial B-point detection, we used the percent of dZ/dt Time + C approach. All ECG and ICG data segments were visually inspected and scored in 60-s intervals, to verify that R-spikes in the QRS complex and the B- and X-points in the dZ/dt wave were correctly scored while also identifying segments with excessive artifact or arrhythmia, consistent with recommendations (Task Force of the European Society of Cardiology the North American Society of Pacing, 1996). At the beginning of data scoring, two trained researchers (the first and second authors) independently scored a random subset of the total data (20%) using MindWare Heart Rate Variability and Impedance Cardiography Analysis Software. Agreement between the two scorers was 96.2% for ECG (when comparing the number of identified R-spikes in each segment) and 95% for ICG (when comparing pre-ejection period values per segment). Disagreements were resolved through discussion. After ensuring sufficient reliability, one researcher (the first author) scored the remaining data.

2.5.1 | Sympathetic nervous system activity

Shifts in cardiac SNS activity were indexed by pre-ejection period (PEP), calculated from ICG (Newlin & Levenson, 1979). PEP reflects the time between the onset of ventricular depolarization and the start of blood ejection from the left ventricle (Berntson et al., 2004), corresponding to the time in milliseconds (ms) between the Q-point and B-point in the corresponding QRS and dZ/dt ensembles. Within person, smaller PEP values (shorter intervals) reflect faster periods of cardiac contractility driven by the SNS while larger PEP values (longer intervals) represent slower cardiac contractility.

2.5.2 | Parasympathetic nervous system activity

Respiratory sinus arrhythmia (RSA) was calculated from the interbeat interval time series (ECG signal) using spectral analysis, based on the high-frequency band of heart

rate variability (0.12–0.40 Hz) after adjusting for confounds with respiration. Prior psychophysiological experiments suggest that RSA reflects vagus nerve outflow to sinoatrial cells, reflecting cardiac parasympathetic control (de Geus et al., 2019). Within person, higher RSA values are consistent with the presence of PNS control, such as during states of rest or relaxation, while lower RSA values are consistent with parasympathetic withdrawal, such as in states of engagement, arousal, or stress.

2.5.3 | Heart rate

Finally, as a supplementary, clinically relevant physiological index that reflects more general autonomic and cardiovascular changes, we extracted HR. HR is calculated from the counted number of R-spikes or "beats" per minute (bpm). Within person, increasing HR suggests greater activity in the autonomic and cardiovascular systems and decreasing HR suggests a decrease in activity or calming of these systems. However, it should be noted that HR reflects contributions from both the SNS and PNS and thus cannot speak to the system specificity of autonomic effects. Still, it is useful to report HR or other similar measures (e.g., interbeat interval) in conjunction with SNS and PNS measures, as this can provide a more holistic picture of the possible interplay between SNS and PNS systems (e.g., autonomic balance; Berntson et al., 2008).

3 | RESULTS

3.1 | Descriptive statistics and preliminary analyses

Preliminary analyses examined descriptive statistics and bivariate correlations for demographic and key study variables (Table 1). Participants endorsed high levels of private regard ($M = 6.61$), low levels of public regard ($M = 2.53$), and moderate levels of centrality ($M = 5.42$). Mean baseline heart rate ($M = 69.02$), RSA ($M = 7.18$), PEP ($M = 124.99$), positive affect ($M = 26.71$), and negative affect ($M = 12.00$) were examined. Next, significant bivariate correlations were examined. Private regard was positively associated with centrality ($r = .37$; $p < .001$) and negatively associated with public regard ($r = -.20$; $p < .001$).

3.2 | Data analysis

Analyses were conducted using the Mixed Models Module of SPSS Statistics, Version 21. Multilevel modeling (MLM) has several advantages over repeated measures analysis of variance including relaxing assumptions of independence and minimizing effects of missing data (Tabachnick & Fidell, 2007). The dependent measures were PEP, RSA, HR, and the affect ratings (PANAS-positive, PANAS-negative). PEP, RSA, HR, and affect scores were calculated for each task: baseline, neutral, non-violent distress, and violence. To calculate change from baseline for each condition, the mean baseline score was used as a reference category, which accounted for the covariance between the two values (mean baseline score and mean condition score) in the model. Using MLM is analogous to calculating a difference score in which the mean baseline score is subtracted from the mean score within each condition as the model simultaneously accounts for intraindividual and interindividual change (Holden et al., 2008). Previous work has demonstrated that using a difference score produces results consistent with using raw scores and controlling for baseline (Neblett & Roberts, 2013).

Of note, when computing PEP, RSA, and HR means, we summarized across all segments, respectively, within the baseline condition and the task conditions of neutral, non-violent distress, and violence. We made the choice to pursue a mean score block design approach, rather than say, a more event-related design because we were primarily interested in demonstrating overall whether there are physiological and affective differences that can be observed in the context of vicarious police violence. Thus, we decided to take mean scores across all segments within each condition because we were not interested in responses to individual photographs but rather the effect of photographs across an entire condition, comparable with common affect induction, emotion elicitation, and stress reactivity paradigms (Kirschbaum et al., 1993; Quigley et al., 2014). Furthermore, we randomized photographs within each condition to reduce order effects between photographs and to create a similar degree of physiological elicitation within a given condition without respect to specific photograph characteristics.

Multivariate models tested whether condition (neutral, non-violent distress, violence) and each predictor (private regard, public regard, centrality) were associated with changes in PEP, RSA, HR, and affect. RSA analyses controlled for body mass index (BMI) given prior recommendations (e.g., El-Sheikh et al., 2009). In line with field recommendations, and to minimize confounds, all analyses controlled for age, sex, and family socioeconomic status (El-Sheikh et al., 2017; Laborde et al., 2017). Consistent with research examining racial identity (Neblett & Roberts, 2013), we created tercile values (low, moderate, and high groupings) to probe significant (continuous) racial identity interactions. Using terciles permitted greater statistical flexibility (i.e., ability to assume a non-linear,

TABLE 1 Means, standard deviations, and correlations with confidence intervals

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	–												
2. Gender	−.117**	–											
3. SES	−.111**	.093*	–										
4. BMI	.146**	−.010	−.195**	–									
5. Private Regard	.045	−.020	−.049	.197**	–								
6. Public Regard	−.166**	.408**	.156**	−.132**	−.198**	–							
7. Centrality	.063	−.246**	.054	.021	.369**	−.193**	–						
8. Baseline HR	.061	−.288**	−.091*	.077*	.088*	−.130**	.090*	–					
9. Neutral HR	.031	−.292**	−.023	.065	.092*	−.094*	.115**	.961**	–				
10. Distress HR	.050	−.255**	−.087*	.088*	.050	−.107**	.089*	.944**	.955**	–			
11. Violence HR	.053	−.290**	−.048	.079*	.051	−.138**	.118**	.963**	.950**	.954**	–		
12. Baseline RSA	−.202**	−.045	−.185**	−.174**	−.167**	.041	−.049	−.459**	−.422**	−.404**	−.417**	–	
13. Neutral RSA	−.216**	−.113**	−.114**	−.136**	−.075*	.023	−.051	−.429**	−.407**	−.398**	−.381**	.860**	–
14. Distress RSA	−.206**	−.071	−.138**	−.224**	−.092*	.061	−.081*	−.391**	−.360**	−.415**	−.404**	.808**	.849**
15. Violence RSA	−.233**	−.086*	−.099**	−.161**	−.120**	.048	−.058	−.419**	−.401**	−.409**	−.407**	.859**	.911**
16. Baseline PEP	.128**	.069	−.050	−.192**	−.051	.129**	−.042	−.252**	−.267**	−.239**	−.308**	−.043	−.144**
17. Neutral PEP	.213**	.119**	−.112**	−.137**	−.073	.151**	−.083*	−.258**	−.276**	−.270**	−.306**	−.043	−.162**
18. Distress PEP	.176**	.105**	−.023	−.177**	−.059	.172**	−.084*	−.342**	−.356**	−.348**	−.386**	.015	−.099**
19. Violence PEP	.186**	.048	−.031	−.187**	−.071	.130**	−.099**	−.287**	−.297**	−.268**	−.313**	−.028	−.137**
20. PANAS Pos. Baseline	.151**	.069	−.032	.067	.095*	.051	−.048	.038	.017	.014	.051	−.076*	−.059
21. PANAS Pos. Neutral	.068	.093*	.017	.075*	.051	.063	.015	.033	.017	.007	.056	−.071	−.049
22. PANAS Pos. Distress	−.016	.210**	.023	−.019	.196**	.175**	−.062	−.076*	−.074	−.105**	−.049	−.061	.027
23. PANAS Pos. Violence	−.025	.198**	−.024	.027	.128**	.184**	−.009	−.129**	−.113**	−.112**	−.097*	−.058	.009
24. PANAS Neg. Baseline	.054	−.009	−.062	.059	−.261**	−.034	−.029	.257**	.246**	.266**	.298**	−.142**	−.158**
25. PANAS Neg. Neutral	−.170**	−.024	−.083*	−.042	.002	−.027	.001	.017	−.001	.000	.040	.075*	.144**
26. PANAS Neg. Distress	−.112**	−.131**	.077*	−.068	−.022	−.113**	.180**	.108**	.068	.048	.129**	.048	.073
27. PANAS Neg. Violence	−.054	−.178**	.108**	.080*	.080*	−.185**	.256**	.021	.008	−.007	.054	.084*	.098**
Mean	23.69	1.45	2.74	26.43	6.61	2.53	5.42	69.02	68.60	67.60	67.95	7.18	7.03
S.D.	3.62	0.50	0.77	5.28	0.48	0.90	1.10	10.95	10.06	9.72	9.92	1.06	1.02
95% C.I.	22.98, 24.41	-	2.59, 2.89	25.38, 27.48	6.52, 6.71	2.35, 2.71	5.20, 5.64	66.85, 71.19	66.61, 70.60	65.68, 69.53	65.98, 69.91	6.97, 7.39	6.83, 7.23

*$p < .05$; **$p < .01$.

non-monotonic association) than if identity scores were treated as true continuous variables. Values that indicate what constitutes low, moderate, and high levels of each predictor are provided below each figure. If the interaction between condition and predictor was significant, post hoc analyses were used to examine the difference of the effect of condition versus baseline for each level (i.e., low, moderate, high). For each model presented, the mean (*M*) value represents the difference between levels of predictor (e.g., moderate vs. low) for a given outcome (e.g., PANAS-negative) within the stated condition. Positive numbers indicate higher levels of the outcome and negative numbers indicate lower levels of the outcome relative to the reference category. As an example, in a comparison of high versus low values of public regard, a mean of −3.74 would indicate that the PANAS-negative score for the high

14	15	16	17	18	19	20	21	22	23	24	25	26	27
–													
.866**	–												
−.047	−.112**	–											
−.075*	−.137**	.883**	–										
−.032	−.085*	.907**	.900**	–									
−.092*	−.121**	.936**	.902**	.911**	–								
−.079*	−.053	−.007	−.016	−.051	−.016	–							
−.066	−.027	−.146**	−.189**	−.130**	−.151**	.630**	–						
.044	.008	−.047	−.034	−.003	−.049	.588**	.659**	–					
.022	−.015	.025	−.002	.056	.028	.515**	.641**	.804**	–				
−.145**	−.119**	−.106**	−.029	−.099**	−.112**	.190**	.173**	−.056	.030	–			
.090*	.120**	−.183**	−.194**	−.202**	−.233**	.173**	.127**	.094*	.218**	.451**	–		
.056	.051	−.234**	−.265**	−.251**	−.263**	.131**	.390**	.120**	.162**	.327**	.438**	–	
.054	.057	−.232**	−.298**	−.234**	−.274**	−.024	.186**	−.101**	.067	.241**	.391**	.728**	–
7.12	7.10	124.99	124.96	124.41	123.86	26.71	25.31	21.20	23.14	12.00	12.31	19.63	22.98
0.95	1.02	10.42	11.36	10.40	10.88	8.74	9.13	6.84	6.69	2.12	4.06	6.76	7.95
6.93, 7.31	6.89, 7.30	122.91, 127.08	122.69, 127.24	122.31, 126.52	121.67, 126.05	24.97, 28.45	23.49, 27.13	19.84, 22.55	21.81, 24.47	11.58, 12.42	11.50, 13.11	18.29, 20.97	21.40, 24.56

group would be 3.74 points lower than the mean for the low group.

To quantify effect sizes for the within-subject contrasts of interest within the multilevel models, a Cohen's f^2 for the local effect size of the contrast was calculated, and then, to aid in interpretability, we transformed Cohen's f^2 into Cohen's d by taking the square root of Cohen's f^2 and multiplying by two (Cohen, 1998). Cohen's d effect size estimates are typically denoted as small (.20), medium (.50), or large (.80). Additionally, when quantifying effect sizes for interactions with our continuous moderators, a Cohen's f^2 for the local effect size of the interaction was calculated. To aid in interpretability, we transformed Cohen's f^2 into partial η^2 wherein partial η^2 = Cohen's f^2 / (1+ Cohen's f^2). Partial η^2 effect size estimates are typically denoted as small (.01), medium (.06), and large

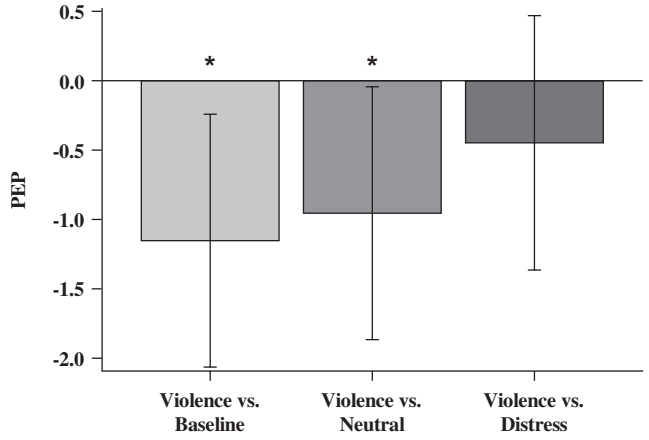

FIGURE 2 Mean pre-ejection period (PEP) reactivity to vicarious police violence relative to the other conditions. *$p < .05$. Error bars depicted are confidence intervals.

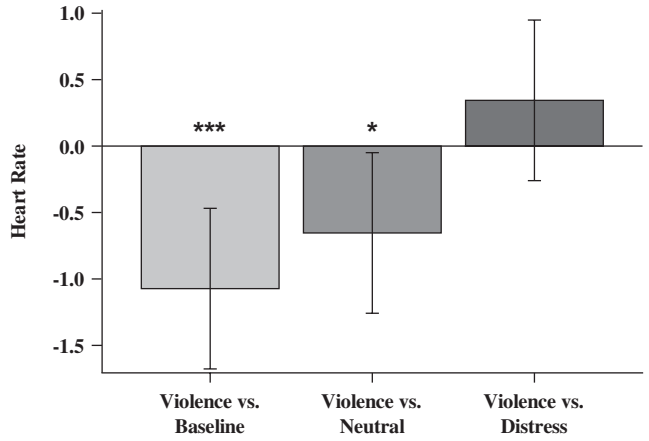

FIGURE 3 Mean heart rate reactivity to vicarious police violence relative to the other conditions. *$p < .05$; ***$p < .001$. Error bars depicted are confidence intervals.

(.14). Finally, the Benjamini-Hochberg (B-H) procedure was applied to all inferential tests to correct for multiple comparisons, and resultant changes in findings are noted (Benjamini & Hochberg, 1995).

3.3 | Research question 1: Does vicarious police violence influence psychophysiological reactivity?

Analyses examined psychophysiological reactivity to the violence condition as compared to the baseline, neutral, or non-violent distress conditions. For PEP, participants exhibited significant change in PEP (i.e., sympathetic activation) to the violence condition relative to the baseline ($M = -1.15$, $SE = .47$, $p = .013$, $d = .05$) and neutral conditions ($M = -.95$, $SE = .47$, $p = .040$, $d = .05$; Figure 2).

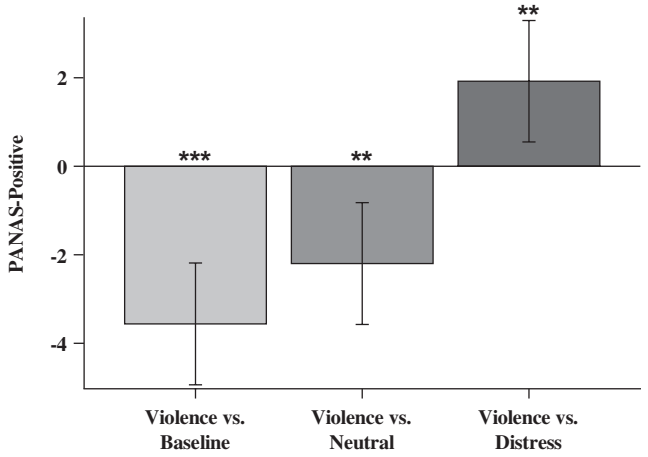

FIGURE 4 Mean positive affective reactivity to vicarious police violence relative to the other conditions. **$p < .01$; ***$p < .001$. Error bars depicted are confidence intervals.

There was no significant change between the violence and non-violent distress conditions ($p = .338$). Participants did not exhibit any significant changes in RSA (i.e., parasympathetic withdrawal) in the violence condition relative to the baseline, neutral, or non-violent distress conditions, suggesting that individuals' parasympathetic regulation remained relatively consistent across conditions. Interestingly, individuals did exhibit significant decreases in HR to the violence condition relative to the baseline ($M = -1.07$, $SE = .31$, $p < .001$, $d = .07$) and neutral conditions ($M = -.65$, $SE = .31$, $p = .034$, $d = .04$; Figure 3), but no significant heart rate differences between the violence and non-violent distress conditions ($p = .264$). The significant increases in SNS activity (i.e., decreased PEP) suggest that photographs depicting violence against Black individuals elicited significant, albeit small increases in SNS reactivity. However, the consistent maintenance of baseline PNS regulation across conditions (i.e., stable RSA) could suggest that the PNS was unperturbed or insensitive to the evocative stimuli. Additionally, the observed small decreases in HR during the violence relative to baseline and neutral conditions may suggest adaptive PNS-dominant cardiovascular downregulation, resulting in slightly calmer HRs despite significant SNS increases.

3.4 | Research question 2: Does vicarious police violence influence affective reactivity?

Analyses examined affective reactivity to the violence condition as compared to the baseline, neutral, or non-violent distress conditions. For PANAS-positive, participants reported lower positive affect in the violence condition relative to baseline ($M = -3.56$, $SE = .70$, $p < .001$, $d = .31$) and

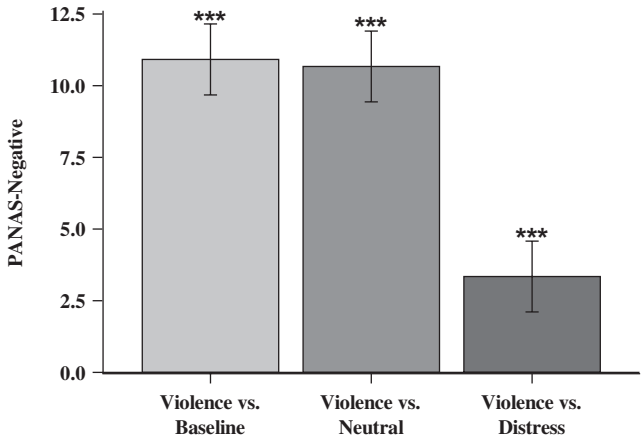

FIGURE 5 Mean negative affective reactivity to vicarious police violence relative to the other conditions. ***$p < .001$. Error bars depicted are confidence intervals.

neutral ($M = -2.19$, $SE = .70$, $p = .002$, $d = .18$), but had slightly higher positive affect in response to the violence relative to the non-violent distress condition ($M = 1.92$, $SE = .70$, $p = .006$, $d = .16$; Figure 4). For PANAS-negative, participants exhibited significantly greater negative affect to the violence condition relative to all other conditions: baseline ($M = 10.92$, $SE = .63$, $p < .001$, $d = 1.36$), neutral ($M = 10.91$, $SE = .63$, $p < .001$, $d = 1.32$), and non-violent distress ($M = 3.34$, $SE = .63$, $p < .001$, $d = .41$; Figure 5).

3.5 | Research question 3: Does racial identity influence psychophysiological and affective reactivity to vicarious police violence?

3.5.1 | Racial identity and physiological responses to vicarious police violence

Private regard

There were no interaction effects of condition × private regard for PEP as the outcome. However, there was a significant neutral × private regard interaction for RSA, $F(2,293.02) = 3.77$, $p = .024$, partial $\eta^2 = .002$. This finding did not survive correction for multiple comparisons ($p = .221$). Post hoc analyses revealed that in the neutral condition, participants with moderate ($M = .31$, $p = .020$) and high ($M = .32$, $p = .017$) levels of private regard demonstrated higher RSA relative to participants with low levels of private regard. There was no significant difference between participants with moderate vs. high levels of private regard. Similarly, there was a significant neutral × private regard interaction for HR, $F(2,294.00) = 3.25$, $p = .040$, partial $\eta^2 = .001$ though this finding was again no longer significant after correcting for multiple comparisons ($p = .200$). Post hoc analyses revealed that in the neutral condition, participants with moderate ($M = 1.55$, $p = .042$) levels of private regard demonstrated higher HR relative to participants with low levels of private regard. Additionally, participants with high ($M = -1.81$, $p = .020$) levels of private regard demonstrated lower HR as compared to participants with moderate levels of private regard. There was no significant difference between participants with low vs. high levels of private regard.

Public regard

With regards to PEP reactivity, there was a significant neutral × public regard interaction, $F(2,284.10) = 4.08$, $p = .018$, partial $\eta^2 = .001$, yet this finding was no longer significant after applying the B-H procedure ($p = .221$). Post hoc analyses revealed that in the neutral condition, participants with moderate ($M = 3.29$, $p = .005$) levels of public regard demonstrated sympathetic inhibition as compared to participants with low levels of public regard who demonstrated sympathetic activation. There was no significant difference between participants with low vs. high or moderate vs. high levels of private regard. When considering RSA reactivity, there were no significant condition × public regard interactions. However, for HR, there was a significant non-violent distress × public regard interaction, $F(2,294.00) = 4.08$, $p = .018$, partial $\eta^2 = .000$. This finding was no longer significant after applying the B-H procedure ($p = .152$). Post hoc analyses nevertheless suggested that in the non-violent distress condition, participants with high levels of public regard demonstrated greater HR as compared to participants with low ($M = 1.66$, $p = .030$) and moderate ($M = 2.04$, $p = .008$) levels of public regard. There was no significant difference between participants with low and moderate levels of public regard.

Centrality

There were no significant interactions between condition and centrality for PEP or RSA. However, there was a significant neutral × centrality interaction on HR, $F(2,294.00) = 3.51$, $p = .031$, partial $\eta^2 = .000$. This finding was no longer significant after applying the B-H procedure ($p = .177$). Post hoc analyses revealed a pattern of findings similar to private regard. In the neutral condition, participants with moderate ($M = 1.74$, $p = .024$) levels of centrality demonstrated higher HR as compared to participants with low levels of centrality. Additionally, participants with high ($M = -1.77$, $p = .021$) levels of centrality demonstrated lower HR as compared to participants with moderate levels of centrality. Nonetheless, there were no significant differences between participants with low vs. high or moderate vs. high levels of centrality.

3.5.2 | Racial identity and affective responses to vicarious police violence

Private regard

There were no significant interactions between condition and private regard for PANAS-positive or PANAS-negative.

Public regard

There were no significant interactions between condition and public regard for PANAS-positive self-reports. However, when examining PANAS-negative self-reports, there was a significant violence × public regard interaction, $F(2,292.18) = 3.22$, $p = .041$, partial $\eta^2 = .006$. This finding was marginally significant after applying the B-H procedure ($p = .054$). Post hoc analyses revealed that in the violence condition, participants with high levels of public regard reported less intense negative affective reactions than participants with low levels ($M = -3.74$, $p = .014$) of public regard (Figure 6). There were no significant differences between participants with low vs. moderate or moderate vs. high levels of public regard.

Centrality

As with private and public regard, there were no significant interactions between condition and private regard for PANAS-positive self-reports. When considering PANAS-negative self-reports, there was a significant non-violent distress × centrality interaction, $F(2,291.49) = 4.74$, $p = .009$, partial $\eta^2 = .009$, even after correcting for multiple comparisons ($p = .021$). Post hoc analyses revealed that in the non-violent distress condition, participants with moderate ($M = 4.07$, $p = .007$) and high ($M = 3.98$, $p = .009$) levels of centrality reported significantly more intense, higher levels of negative affect than participants with low levels of centrality (Figure 7). There was no significant difference between participants with moderate vs. high levels of centrality. There was also a significant violence × centrality interaction, $F(2,291.78) = 8.72$, $p < .001$, partial $\eta^2 = .020$, even after correcting for multiple comparisons ($p < .001$). Post hoc analyses indicated that in the violence condition, participants with moderate ($M = 5.65$, $p < .001$) and high ($M = 5.25$, $p = .001$) levels of centrality demonstrated significantly more intense negative affective reactions to depictions of police violence than participants with low levels of centrality (Figure 7). There was no significant difference between participants with moderate vs. high levels of centrality. When the non-violent distress and violence conditions were directly compared, individuals with low ($M = 2.39$, $p = .025$), moderate ($M = 3.97$, $p < .001$), and high ($M = 3.68$, $p = .001$) levels of centrality all demonstrated significantly more intense negative affective reactions to photographs in the violence condition relative to photographs in the non-violent distress condition.

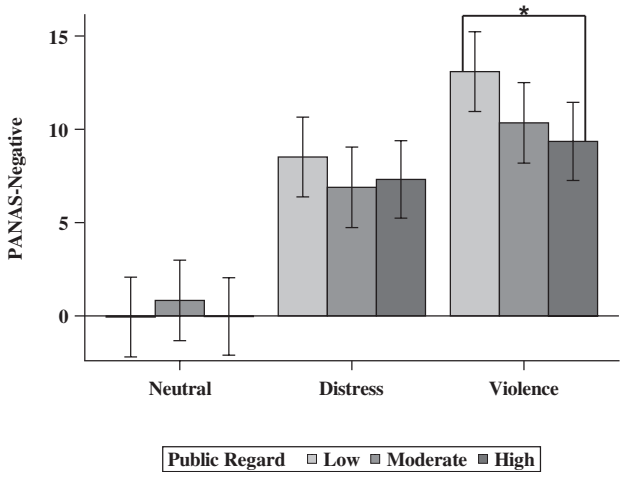

FIGURE 6 Mean negative affective reactivity to condition presented by level of public regard (low = 1.50; moderate = 2.53; high = 3.50). *$p < .05$. Error bars depicted are confidence intervals.

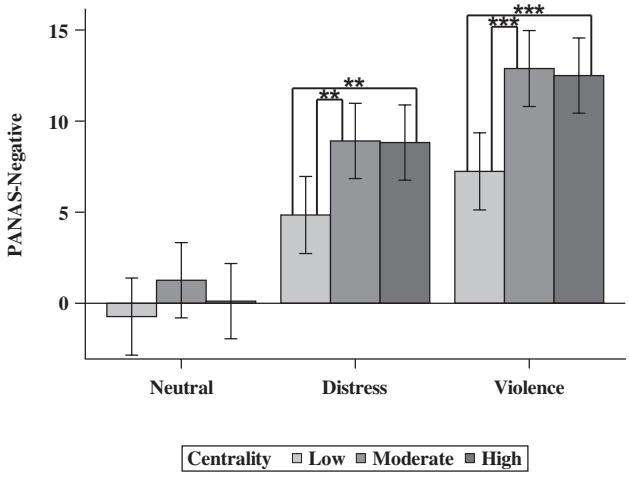

FIGURE 7 Mean negative affective reactivity to condition presented by level of racial centrality (low = 4.13; moderate = 5.62; high = 6.47). **$p < .01$; ***$p < .001$. Error bars depicted are confidence intervals.

4 | DISCUSSION

4.1 | Vicarious police violence and psychophysiological reactivity

Photographs depicting the assault and shooting deaths of Black individuals were associated with significant shifts in autonomic psychophysiology. Specifically, there was greater SNS reactivity to the violence condition (vs. neutral or baseline conditions), as evidenced by faster PEPs. Interestingly, there was no difference in the SNS response between the violence and non-violent distress conditions. This could be because the non-violent distress condition is not completely "free" of racism. Although there were no photographs of police brutality in the non-violent distress

condition, photographs of Black people living in poverty or wading through the waters of Hurricane Katrina were included. These photographs arguably represent systemic racism and may be as distressing as photographs depicting vicarious police violence. It is also possible that although the violence and non-violent distress conditions differed slightly in terms of their valence, both sets of photographs were still overall negative and likely highly arousing. Given this, it may be that both vicarious police violence and more general vicarious distress are highly arousing experiences that are similarly relevant and evocative for SNS upregulation. Given that vicarious distress is a common element in empathy (Merritt et al., 2021; Zaki et al., 2016), this suggests that vicarious police violence may similarly capitalize on an individuals' empathic capacity to simulate and put themselves in the shoes of the individual being discriminated against. Indeed, empathy—and empathic fatigue over chronic exposure (e.g., Cameron & Payne, 2011)—may be one possible reason why key identity elements such as racial centrality may serve as a *vulnerability* factor (Rucker et al., 2014), a finding further corroborated by the present study's findings on racial centrality discussed below.

Contrary to hypotheses, we did not find any effects of the violence condition on RSA. Although it is difficult to interpret null effects, there are several possible reasons why we did not observe condition effects on RSA. First, much evidence shows that the SNS and PNS can exhibit coactive vs. reciprocal vs. independent patterns (e.g., Berntson et al., 2008). Thus, whether due to features of the task or context or due to individual physiological differences within the sample, it is possible that this null RSA effect reflects an active coping response in the violence condition without the suspension of "rest and digest" PNS functions, given that participants were not in immediate danger. Similarly, it is possible that although the intensity of stimuli was sufficient to induce an SNS response, each condition only lasted 3 min which may not have been sufficient to evoke a strong PNS response. However, it is worth noting that in parallel to PEP/SNS reactivity, we found significantly decreased heart rate reactivity for the violence condition relative to baseline and neutral conditions. The lack of RSA changes yet significant decreases in HR may altogether suggest adaptive PNS-dominant cardiovascular regulation, producing slower HR despite significant SNS increases. Future work capitalizing on pharmacological blockades (e.g., propranolol) could help disentangle these complexities in the autonomic pathways underpinning cardiovascular responses to vicarious police violence.

Finally, because we were primarily interested in demonstrating, as a first step, whether there are physiological and affective responses to vicarious police violence, we focused on between-condition comparisons and used shorter measurement periods (3-min each condition). However, it is possible that there are important within-condition cognitive and physiological temporal effects that are masked by this approach. For example, the vicarious police violence vs. vicarious non-violent distress conditions might have differed in their temporal processing effects—such as early orienting or defensive responses vs. later habituation or adaptation responses—effects that we cannot disentangle herein. A more nuanced, within-block, or event-related design approach would be an ideal next step to better identify temporal effects within psychophysiological reactivity to vicarious police violence.

4.2 | Vicarious police violence and affective reactivity

The findings for negative affect were consistent with hypotheses: the violence condition elicited robust increases in self-reported negative affective feelings relative to another negative, but non-violent experience (i.e., distress) vs. neutral and baseline ratings. These findings parallel previous research suggesting that negative affect is a common response to discrimination (e.g., Carter & Forsyth, 2010). It is no surprise that viewing such disturbing photographs would elicit negative affect among Black adults as these photographs may serve as reminders of the (myth and/or illusion of the) inferior status of Black people and the impunity with which they are murdered.

As expected, there were also significant, moderate decreases in positive affect in the violence condition compared to the neutral condition. Contrary to expectations, there was slightly greater positive affect to the violence relative to the non-violent distress condition. This does not necessarily imply that participants were "happier" in the violence condition, given that the violence condition also was significantly higher in negative affect ratings. Indeed, a closer examination of the items on the positive affect subscale indicated that relative to the non-violent distress condition, participants reported higher mean ratings of the items *alert*, *attentive*, *determined*, and *active* following the violence condition. Though included under the positive affect subscale, these items are not always "positive" per se in affective norming systems (Bradley & Lang, 1999; Stevenson et al., 2007; Warriner et al., 2013) nor in stress responses where such items can indicate high arousal states involving vigilance, challenge, and threat (Blascovich & Mendes, 2010; Trotman et al., 2018). Thus, although speculative, these endorsed "positive" items may reflect higher arousal responses in the violence condition. For example, the violence condition, as an induction of vicarious police violence, elicited greater SNS activity. Thus, it is reasonable to consider

that the violence condition may have also induced SNS-related high arousal states captured in the positive affect subscale, such as greater vigilance toward the salient violence photographs (e.g., "alert" and "attentive" items) as well as greater challenge responses where individuals felt more agentic (e.g., "determined"), alongside the parallel negative subscale items reflecting challenge and threat responses such as anger, fear, and sadness. This diversity of responses helps illustrate the complexity of affect elicited by vicarious police violence (S. C. T. Jones et al., 2013).

4.3 | Racial identity as a moderator of response to vicarious police violence

Though some interesting patterns emerged with regard to the interactions of condition and racial identity characteristics on physiological reactivity, these very small effects did not withstand correction for multiple comparisons. In contrast, there were several illuminating small to moderate effects on negative affective reactivity found for interactions between condition and racial identity characteristics. Specifically, individuals with moderate and high levels of centrality demonstrated significantly more intense negative affect when viewing the non-violent distress and violence conditions relative to individuals with low levels of centrality. Furthermore, when the non-violent distress and violence conditions were directly compared against each other, individuals with low, moderate, and high levels of centrality all demonstrated greater negative affect in the violence condition as compared to the non-violent distress condition, although this violence > distress effect was weakest for individuals with low centrality. Consistent with hypotheses and previous research (e.g., Mason et al., 2017; Rucker et al., 2014), these findings suggest that Black adults who regularly define themselves with regard to race across situations are more likely to report negative affect when experiencing vicarious police violence or seeing ingroup members in distressing circumstances.

Why might greater levels of centrality, which has been identified as a protective factor, be associated with negative affect? One answer is that both vicarious police violence and vicarious distress involve an element of empathy and empathic distress as noted earlier. Research indicates that relative to other racial groups, Black individuals show greater empathy toward ingroup members (Brown et al., 2006). One study found that Black participants with low racial identification demonstrated less empathy toward a stereotypical Black man (e.g., listens to rap music) compared to a counter-stereotypical Black man (e.g., listens to classical music) who was an unarmed victim of a police shooting (J. D. Johnson et al., 2019). Thus, Black individuals with higher racial centrality may report more emotional distress when experiencing vicarious police violence not only due to higher levels of empathy (e.g., putting themselves or loved ones in the shoes of the victim) but also because the importance of race in their lives may make instances of racial discrimination particularly salient and disparaging. These findings should challenge researchers to be increasingly thoughtful about how environment and context can influence the manifestation of individual differences—no individual difference should be considered inherently good or bad (Sellers et al., 1998), and the same factor may prove adaptive, maladaptive, or inconsequential contingent on circumstances. Interestingly, there was little found with private regard, but that may be because on average, most participants in the study had higher levels of private regard. On the other hand, there was a somewhat broader range for public regard and a clear broad range for centrality, which may help explain why we were able to detect the cleanest interactive effects with centrality.

4.4 | Implications

One possible real-world implication of these findings is that Black individuals may wish to limit their consumption of media depicting the assault and shooting of Black individuals, as it can elicit large increases in negative mood and smaller yet significant changes in physiological reactivity. It is important to increase awareness of how vicarious police violence may impact health. In some ways, it appears these pernicious effects are intuitively known as people often declare social media breaks and commiserate about the exhaustion and irritation endured at work or school following—yet another—murder. Consistent with the theory of embodiment, bodies often tell stories that individuals cannot articulate because they "are unable, forbidden, or choose not to tell" (Krieger, 2005, p. 350). Over time, constant exposure to these kinds of media against same-race individuals may lead to empathic fatigue and withdrawal as a self-protective regulation strategy against the deeper psychological and physiological toll of such exposures (Cameron & Payne, 2011; Zaki, 2014). Furthermore, individuals with higher racial centrality may be especially vulnerable to the deleterious effects of such media, given the present findings that moderate and high centrality can intensify the experience of vicarious police violence. Although such photographs and videos are often shared and reposted on social media with the important goal of bringing necessary attention to injustice within our society, others may view this content

before realizing the content's graphic or distressing nature. Trigger warnings or similar notation in tags or titles on such content would help individuals be able to better choose when and where they engage with distressing media.

Also, interventions that focus on reducing physiological arousal and negative affect immediately after exposure to vicarious police violence may prove helpful. While Black individuals have not caused the oppression they endure, the perpetrators of this oppression—who should bear full responsibility for their actions—often have no stake in the protection and healing of Black bodies. Mindfulness interventions have been associated with increased experiences of positive emotions and reduced stress reactivity (Geschwind et al., 2011). Trait mindfulness has been found to have a buffering effect on the relationship between past experiences of racial discrimination and mood symptoms (Graham et al., 2013; Zapolski et al., 2018), suggesting that increasing mindfulness may improve mood symptoms. Recent preliminary work indicates that racially-adapted meditation may facilitate physiological recovery following vicarious harassment (Hargons et al., 2021). And yet a cultural-psychological approach asserts that it is the water, not the fish, that must change: "It may do little good to address racism by changing people's dispositions if they will return to the same racist worlds that constituted those dispositions in the first place" (Salter et al., 2018, p. 153). Generations of Black people have exhibited resilience in the face of unspeakable dehumanization, but resilience and coping strategies are but Band-Aids on a dam: societal, cultural, organizational, and individual changes that result in the cessation of police violence are the best solutions.

4.5 | Strengths, limitations, and future directions

Strengths of the current study include using a novel lab-based paradigm to examine vicarious police violence, measuring both psychophysiological and affective reactivity, and assessing dimensions of racial identity as moderators. Another important strength is the study's focus on a diverse sample of Black young adults. Although it is common practice to focus on racial differences in studies such as this, examining racial differences can be problematic for several reasons. Comparing Black vs. white participants may imply that white individuals are the normative baseline against which non-white "others" are measured and can also serve as a substitute for inadequate recruitment of Black individuals while failing to more richly capture the diversity within Black identities and experiences (Anderson et al., 1991).

One key limitation to the study is the "passive" nature of the experimental manipulation, which may underestimate the physiological impacts of vicarious police violence (Mendes, 2009). It is possible that a more evocative task, such as asking participants to make a speech regarding the impact of police violence on the Black community, would have elicited a stronger physiological response. Other limitations are that, based on the physiological indices and block study design used, we cannot fully explain the null RSA effects nor address within-condition temporal effects. Building on these first steps, future studies should replicate and extend our findings to provide a more comprehensive, complex understanding of the acute and chronic physiological and psychological effects of vicarious police violence.

Finally, although there were moderate to very large effects found for vicarious police violence on negative and positive affective ratings, the effects of vicarious police violence on psychophysiology variables were small. This is perhaps unsurprising given that individuals were passively sitting alone throughout the tasks and given that the conditions were very brief (3-min each). We sought to ameliorate potential issues with statistical power by capitalizing on a within-person repeated condition design—which may be why we detected small effects on PEP and HR. Nonetheless, we recommend that future studies should replicate this study in a larger Black sample to verify if the small PEP and HR and null RSA effects remain consistent. However, we note that using brief presentations of photographs depicting police violence is likely comparable to real-life experiences where Black individuals see such depictions in the news or on social media. Nonetheless, future studies might benefit from using event-related designs and more extensive, dynamic stimuli such as video clips to further capture potential psychophysiological effects of vicarious police violence.

4.6 | Conclusion

Understanding the deleterious effects of vicarious police violence (and intergroup violence more generally) is not merely an intellectual endeavor, but also a troubling reality for Black individuals in the United States. Of course, the negative effects of vicarious police violence are best reduced by addressing the structural, cultural, interpersonal, and individual factors that might lead to police violence in the first place. In parallel, ongoing research and policy efforts should strive to provide efficacious solutions that help individuals and local communities confront vicarious violence (e.g., interventions, resources, social support, grassroots action). Finally, although the present work has focused on the experiences and reactions of Black

individuals residing in the United States, our findings may generalize to the experiences of other marginalized groups—whether in the United States or other nations—where intergroup violence is enacted and perpetuated. It is critical that future research better understand the detrimental physiological and psychological effects of vicarious intergroup violence and related traumas if we are ever to build a just society and world that supports the health and flourishing of all.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTIONS

Effua Erica Sosoo: Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; writing – original draft; writing – review and editing. **Jennifer Kay MacCormack:** Formal analysis; writing – review and editing. **Enrique W. Neblett, Jr:** Supervision; writing – review and editing.

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