The Effects of Police Violence Media on

Physiological and Reported Stress in White People

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Abstract

Police violence against the Black community in the United States is often protested by social media movements such as #BlackLivesMatter. Investigations into stress responses elicited by exposure to police violence media have shown that White people experience a lack of racial stamina eliciting desensitization. To examine differences in stress response based on the race of police gun violence victims, a between-subjects factorial experimental design was used. In the present study, electrocardiograms and survey measures were utilized to measure stress. The conditions in the present study used identical social media posts depicting two victims of police gun violence; a White man (Condition 1) and a Black man (Condition 2). Physiological data was collected during three phases of the study; the Baseline, Stressor, and Recovery periods, and survey data was collected during the Baseline and Stressor periods. Two hypotheses were proposed; 1) there will be a significant increase in survey-reported and/or physiological stress measures between the Baseline and Stressor periods, and 2) these significant increases will be lesser in Condition 2 than Condition 1. Results of Paired-Sample T-Tests demonstrated significant differences between the Baseline and Stressor periods for both conditions and in both survey Measure. No significance was found between these periods for any physiological ECG features collected. In addition, no significance was found between conditions for any ECG features or survey responses. This study provides insight into the effect of police gun violence media on stress not previously studied and lays the base for continued research into race-based differences in stress responses.

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The topics of race and ethnicity in the United States and around the globe are sensitive subjects often discussed in a highly politicized manner, especially following the shooting of George Floyd on May 25th, 2020 (Hill et al., 2020). This shooting was not the first, but one of many instances of police violence against members of the Black community. Between the years of 2018 and 2021, Black people made up 38% of all police killings of unarmed victims, even though only 13% of the US's population identifies as Black (*2017 Police Violence Report, 2017*). This history of violence can be traced back to the starting point of slavery in America in 1619, when 20 enslaved Africans were shipped to Jamestown, Virginia by European conquistadors (History.com Editors, 2019). The legacy slavery has left in the United States has created a culture of bias against Black Americans. This bias comes in the forms of systemic and interpersonal racism, stereotyping, discrimination, and prejudice against the Black community. These harmful practices persevere in 2022 and can be found in the legal, healthcare, educational systems, and more, manifesting as heightened incarceration rates for Black men, maternal mortality rates for Black women, and racial disparities in gun violence (The Lancet, 2021; Rezal, 2021; Center for Disease Control and Prevention, 2019; *2017 Police Violence Report, 2017*).

Unfortunately, due to the United States' extensive history of racism in the legal system, there is a never-ending flow of social media posts citing yet another unarmed Black person being killed by White police officers. The frequency of activism reports on one's feed can feel overwhelming, as it becomes evident that this pattern of violence is never ending. In White people, the flow of media addressing the systematic oppression may even elicit reactivity to the topics, taking the form of guilty, argumentative, or even muted responses to the violence (Diangelo, 2011). In summation, these responses are a result of a decreased tolerance to racial stress caused by the lack of exposure White people have to experiencing racism (Diangelo,

2011). The common term for this lack of racial stamina is “White Fragility”, and it plays an important part in upholding the systems that disadvantage minority communities to this day. When White people become overwhelmed by the knowledge that they are empowered while others are not, they may withdraw from the situation or information that is causing them stress. This withdrawal could be a physical movement away from the stressful situation, or it could take the less obvious form of emotional distancing in order to reduce cognitive dissonance. Emotional desensitizing responses to media discussing racial disparities has already been documented across a variety of disciplines. One such study on COVID-19 racial disparities conducted on residents of the United States found that the more a White individual recognized race-based COVID-19 health disparities, the less they feared COVID-19, and the less they supported safety precautions such as masks or vaccines (Skinner-Dorkenoo et al., 2022). Subsequently, the more these participants recognized the same racial health disparities, the less fear for or empathy they expressed towards the communities more vulnerable to COVID-19 (ie. People of Color) (Skinner-Dorkenoo et al., 2022). This was especially true when the COVID-19 incongruencies were framed as a continuum of race-based health disparities (Skinner-Dorkenoo et al., 2022). This study is directly applicable to the effect of a White identity on emotional responses to race-based policing inequalities in the Black community; the more a White person is exposed to media about policing inequalities, the greater White Fragility they may experience, and the less empathy they’ll have towards the vulnerable population. Another relevant study applicable to Whiteness and social injustices examined children’s views on structural inequalities (ie. gender) versus merit-based inequalities by assigning each child to a group with more or less resources. The investigators found that the children sorted into the advantaged groups were less likely to view the structural inequalities as wrong and less likely to take action to correct the inequality

than the disadvantaged children (Rizzo & Killen, 2020). Though this study didn't examine the advantaged children's emotional attitudes towards the disadvantaged children or the inequalities affecting them, it is possible that one explanation for their viewpoints is a decreased emotional sensitivity to the disadvantaged group as a whole. This theory is supported by research on autonomic arousal, eye-tracking, and own-race bias; a decrease in sensitivity to racial out-group members is caused by a strong emotional state activating the sympathetic nervous system, which in turn causes a change to pupillary response and diameter, which affects the processing of faces and their respective races (Lim et al., 2020; Wu et al., 2012). Reactivity responses observed in White populations cited by previous literature may be applicable as examples of such emotional states causing autonomic activation (Diangelo, 2011)

From the research detailed above, it is evident that both the racial or ethnic identity of a reader reduces their emotional reaction to the subjects discussed and empathy towards the minority group. Furthermore, it is evident that this desensitization induces attitudes and responses in White people that decrease support for policies working protect or empower vulnerable populations. Emotional desensitization, especially to police violence against the Black community, is extremely harmful to movements such as Black Lives Matter, which works to protest the US's inherently racist legal system. For that reason, this study sought to examine if White people produce less of an emotional response to police violence social media with a Black victim as compared to a post with a White victim due to the desensitizing effects of White fragility.

Literature Review

Research in the field of emotion detection, also known as affective computing (AC), is a rapidly growing field in neuroscience being utilized primarily for assessing physiological

emotional states of individuals during interactions with computer interfaces (Calvo et al., 2010). One such study conducted a review of relevant systems used in emotion detection such as fMRI and electrophysiological techniques (Calvo et al., 2010). These systems demonstrate high accuracies in emotion detection and are objective measurement systems with the added benefit of being non-invasive (Calvo et al., 2010). This made them highly desirable for the study at hand, as this method enabled participants to be easily connected to electrophysiological equipment while reading about police violence. Electrophysiological measurement of emotion is also less susceptible to response bias. Included in this paper are some important takeaways from previous physiological research that were also applicable, including the law of initial values (LIVs), Arousal measures, Stimulus-response (SR) specificity, Individual-response (IR) specificity, cardiac-somatic features, and habituation and rebound features. LIVs describes that a physiological stimulus depends on the pre-stimulus physiological level (ie. With a higher initial physiological level such as heart rate [HR], a smaller response is expected). Arousal measures describes the state of excitement participant is in. Theory related to arousal measures describes that how aroused or excited a participant is will effect performance of AC measures (ie. High arousal in participants leads to low performance of AC). It is unclear if the arousal-performance relationship has effects on *accuracy* of AC measures, however there is evidence of levels of participant arousal associated with best performance of AC (Cacioppo et al., 2007). SR specificity theorizes that for a particular stimulus, participants will experience a specific physiological response. This theory is supported specifically in physiological research on the Autonomic Nervous System, such as electrocardiograms (ECG), which measure the electrical activity of the heart (Ekman et al., 1983; Calvo et al., 2010). Cardiac-somatic features of physiological-based emotion detection refer to heart activity differences while a behavioral

response is taking place (Calvo et al., 2010; Faria & Almeida, 2013). Finally, habituation and rebound are two effects taking place in response to a stimulus. Rebound is a decrease in physiological responses to stimuli followed by a return to the pre-stimulus level, whereas habituation is the decrease in the physiological responsivity to stimuli overtime; essentially habituation is a conditioned response to repeated stimuli (Calvo et al., 2010). These theories of physiological research are key to take into account when studying physiological affect detection, as without consideration they could affect the accuracy and repeatability of results.

Recent research in the field of physiological emotion detection has focused on electrocardiograms (ECGs) and blood pressure as the most reliable and accurate technologies in AC, with accuracy averages above 90% (Hasnul et al., 2021; Arza et al., 2018; Karthikeyan et al., 2011). Once such review describes the complexities of quantifying emotion responses, and outlines two emotion models accepted in the psychophysiological community. These models, the Discrete Emotion model (DEM) and Affective Dimensional model (ADM) are utilized to categorize emotions based on their respective electrophysiological features (Hasnul et al., 2021). The first of these models is the DEM which assists in categorization. This model outlines a set of basic emotions that which all other emotions derive from. Though the emotion categories of the DEM vary, the standard set first proposed by Ekman include happiness, sadness, anger, disgust, fear, and surprise (Bulagang et al., 2020; Ekman et al., 1983; Hasnul et al., 2021). The next model, the ADM, allows for a wider range of emotions to be categorized by their electrophysiological features. Also named the continuous dimension model, the ADM utilizes valence and arousal to sort emotions based on their level of positivity and excitation respectively. The ADM is commonly used in electroencephalogram (EEG) research to categorize collected EEG wave data into different emotional states being experienced by the participant, however in

ECG research heart rate (HR), heart rate variability (HRV), blood volume pressure (BVP), and other measures are the more common and precise measures of emotional variation (Ekman et al., 1983; Hasnul et al., 2021).

Variations in the physiological ECG features collected by researchers' changes based on what kind of stress is being measured, the amount of time data is collected for, and the stimuli used to induce stress. In order to narrow down what features are most accurate when measuring short-term mental stress, several articles were reviewed for accuracy, frequency of use, and significance. The first of these studies reviewed the four main physiological pathways of stress; those being Neurohypophysis activation, Hypothalamic-pituitary-adrenal (HPA) axis activation, Sympathoadrenal system activation, and Nervous system activation. Neurohypophysis activation refers to the secretion of vasopressin by the central nervous system (CNS) leading to increased blood volume (BV), BVP, and peripheral blood vessel resistance (Arza et al., 2018). HPA axis activation references the secretion of cortisol to increase metabolism, inhibit anabolism, and depress the immune system (Arza et al., 2018). Sympathoadrenal system activation triggers increased sensitization of the sympathetic nervous system (SNS), which is responsible for the fight-or-flight response (Arza et al., 2018). Finally, Nervous system activation is characterized by SNS activation combined with parasympathetic nervous system (PNS) inhibition, which causes increased heart and respiratory rate, pupil and bronchial dilation, sweating, increased blood sugar, and inhibition of digestive muscles (Arza et al., 2018). Research has shown that using a multivariable approach, such as measuring at least one feature of each of the four pathways, is more accurate than utilizing a single feature or single pathway (Arza et al., 2018). Due to limitations in equipment access, only three stress pathway measurements we're utilized.

Of the possible features that can be collected using ECG, the most common, reliable, and accurate is said to be HRV (Egger et al., 2019; Arza et al., 2018; Kim et al., 2018). HRV refers to the time or frequency variation between heart beats, and falls into the HPA axis activation, Nervous System activation, and Sympathoadrenal system activation pathways of stress (Arza et al., 2018; Kim et al., 2018). In analysis, HRV is associated with decreased Autonomic Nervous System (ANS) activity, which affects internal stress, so in this feature it may be crucial to see greater HRV during exposure to the Black victim media as compared to the alternative (Kim et al., 2018; Dimitriev & Saperova, 2015). There are two common analysis methods of HRV features: frequency-domain and time-domain. Time-domain analysis focuses on measuring time differences between beats whereas Frequency-domain assesses frequency differences. The latter of these domains is the more popular option for short term physiological stress research (Kim et al., 2018). Furthermore, the frequency measurements are divided into high (0.15 - 0.40 Hz) and low power (0.04 - 0.15 Hz) (Kim et al., 2018). There is further division of these domains into very low frequency (VLF) and very high frequency (VHF), however these measurements have not been shown to add additional insight into stress levels. Kim et al., 2018 finally notes "…low parasympathetic activity as a factor of stress and HRV, which is characterized by a decrease in high frequency (HF) and an increase in the low frequency (LF)…". The finding regarding change in HRV positively correlating with stress levels has generally been supported in short term HRV stress research, however there is some discourse regarding directionality of LF/HF change (Kim et al., 2018). For the study at hand, HF and LF were collected and assessed for overall variability changes rather than directionality.

Another feature collected by ECG machines is heart rate, or the number of heart beats per minute, which has shown significant changes upon exposure to stressful stimuli and is a popular

feature collected in affect detection (AD) research ($p < 0.0001$; Bhide et al., 2016; Hasnul et al., 2021; Arza et al., 2018). It falls into the Sympathoadrenal system activation and Nervous system activation pathways of stress as well, and although HRV are also in these categories, collecting both features for the most accurate results. For heart rate, increased frequency in beats per minute is associated with an increased "fight or flight" stress response, so an average increase in HR upon exposure to the media and an overall lower increase when the media depicts a Black victim versus a White one would indicate desensitization (Hasnul et al., 2021).

Specific ECG markers such as PR interval, QT interval, RR interval, QRS interval, and more have also been collected and evaluated to show significant correlation to stress levels in people (Bhide et al., 2016; Kim et al., 2018; Tzevelekakis et al., 2021). For RR intervals, research has shown a decrease in the interval negatively correlating with mental stress (Kim et al., 2018).

Since the above features of ECG are shown to be reliable sources of stress measurement, they were utilized to assess mental stress levels in the participants of this study. For the specific ECG markers, RR interval, HRV, and HR were collected for analysis of increased stress in association with decreased RR interval, increased HR, increased LF band power and decreased HF band power for HRV (Arza et al., 2018; Hasnul et al., 2021; Kim et al., 2018).

These studies cover in depth physiological technologies, however collecting emotional, anxiety, or stress-based survey data have also shown to be promising methods of affect assessment. Scales such as the Perceived Stress Scale (PSS-10) and the State-Trait Anxiety Index (STAI) are popular psychometric tools utilized to asses both current and overall feelings of anxiety. Recent investigations into the validity of both scales have shown them to be reliable and valid when measuring anxiety, even when applied to distinct population samples in several

languages (Baik et al., 2019; Gustafson et al., 2020; Julian, 2011). These scales differ in that the STAI is a much longer survey, with 40 items to the PSS's 10 and 14-item measures. Benefits of the STAI include Likert-scale measures to assess an individual's present feelings of anxiety and stress using both negative and positive affect wording. This enables researchers to examine both an individual's level of negative and positive emotionality they are experiencing in the moment simultaneously. Limitations of the STAI assessed by current research show a decrease in responsiveness to the "Trait" scale in comparison to the "State" scale (Julian, 2011). In addition, the "Trait" scale demonstrated decreased sensitivity to changes over shorter durations of time (Jullian, 2011). In comparison, the PSS-10 shows consistently high scores of reliability, sensitivity, and validity while utilizing a similar Likert scale of measurement (Baik et al., 2019). Limitations in the applications of the PSS-10 to the study at hand include the inability to measure current state, as well as the focus of feelings on current life events lacking application to the present research (Baik et al., 2019). Due to the popular usage of survey measures in stress detection research, it would be beneficial to utilize a combined-measures methodology to collect data on individuals reported and physiological states. This also may enhance the reliability of collected data if two contrasting methods of data collection yield comparable results.

When looking at differences in both physiological and reported emotional responses to stimuli elicited through reading or looking at pictures, there was little research conducted specifically on race and police-violence. The only article relevant to studying race, emotional responses, and the effect of traumatic experiences examines how experiencing race-based traumatic events affects emotional responses in different racial groups (Carter et al., 2019). Although certainly relevant, this study utilized The Race-Based Traumatic Stress Symptom Scale solely; A survey with 52 measures and 7 scales to report emotional responses to traumatic

experiences and not necessarily a combined methodology (Carter et al., 2013). It also examined the effect of personal trauma experiences on emotional responses using a 5-point Likert scale, which differs significantly from second-hand exposure to trauma-related media (Carter et al., 2013).

In order to address gaps of knowledge in desensitization to race-based police violence, it is essential to measure emotional responses. Cardio-somatic features to assess emotional reactions to media discussing police shootings of Black people may reveal that White people are physiologically desensitized to these types of traumatic events. However, using physiological methods to measure emotional responses in combination with survey measures may provide increased insight into participant's affective states. To best examine affective reactions to social media posts on police-violence against the Black community, ECG data collection was used continuously along with survey measures. The ECG data collected included HRV, HR, and RR interval using a standard lead configuration of three electrodes and respective leads at the anterior non-dominant wrist and both distal posterior calf muscles. The STAI was the chosen survey method due to its reliability and validity in measuring current anxiety state, however required alterations to increase sensitivity and be efficiently utilized for the study at hand. The surveys formed from this were named the Positive Affect Measure and Negative Affect Measure.

Due to the stressful nature of violent media, it was hypothesized that all individuals will show a stress response to reading both posts. However, because of the desensitizing effects of Whiteness combined with White fragility, participants exposed to the media depicting a Black victim were not expected to elicit *as much* of stress response as those exposed to the White victim media. The stress response was characterized by the demonstration of the following features; decreased HF and increased LF band power in HRV, increased HR, decreased RR

interval, decreased Positive Affect Scale (PA) scores, and increased Negative Affect Scale (NA) scores as compared to the baseline. The desensitization response was defined as a smaller decrease in HF power and smaller increase in LF power for HRV, a smaller increase in HR, a smaller decrease in RR interval, a smaller (mean difference) decrease in PA score, and a smaller (mean difference) increase in NA scores as compared to the baseline. It was predicted that participants will show a lessened emotional/stress response to the police violence media depicting a Black due to individuals experiencing own race bias and White fragility (Diangelo, 2011; Wu et al., 2012).

Methods

Participants

Participants in this study were convenience sampled from Allegheny College students using the SONA research participation system, flyers, social media posts, in-class presentations, and word of mouth. The student population at this College is 67.7% White, 8.7% Latinx, 8.58% Black or African American, 4.02% Mixed Race, 3.6% Asian, and .03% Native American (*Allegheny College – Data USA,* n.d.). The student population is 56% female and 44% male, with no information included on non-binary student population (*Allegheny College Diversity: Racial Demographics & Other Stats*, n.d.).

Eligibility requirements for the present study include an age requirement of 18 years or older, current enrollment as an Allegheny College student, and identifying as White – American, Caucasian – American, or Euro – American. Since this study assesses White populations emotional responses, participants were excluded if they identified with a Black, Indigenous, and People of Color (BIPOC) identity. To qualify as BIPOC, a participant must identify as being a member of any of the following racial groups; Asian or Asian American, Black or African

American, Native American or Alaska Native, Native Hawaiian or other Pacific Islander, or Multiracial. Participants also had the option to select multiple races, so if one of these options was selected along with the White, Caucasian American, or Euro-American option, they would not be eligible for participation. Participants were also disqualified if they identified with either of the following ethnic groups; Non-White Latinx/Hispanic, or Arab, Middle Eastern, and/or North African descent. In order to ensure that BIPOC students were able to receive the same compensation that White students were offered, they were allowed to register and attend their appointments, however no data was collected or analyzed from them. In summation, all participants that participated were over the age of 18, and were assumed to identify as non-Arab, non-Hispanic/Latinx White, Caucasian American, or Euro-American, or non-Arab, Hispanic/Latinx White, Caucasian American, or Euro-American.

Two forms of registration were used for the present study; the SONA research participation system and a Qualtrics survey (Appendix A). The Qualtrics survey collected data on the age and racial or ethnic identities of potential participants, however the SONA system did not. This is due to how SONA is setup: one can only collect data on the racial/ethnic identities of participants for disqualification purposes. For this reason, participants who participated in this study via SONA registration were assumed to be eligible based on the above qualifiers. If participants registered through the SONA system and appeared to be BIPOC-identifying, no data was collected from them and they were given compensation for their time. Of the total number of participants recruited, nine registered through the SONA system and 18 registered through Qualtrics. No data was collected on the gender of participants.

Design

The present study conducted was a 3x2 Factorial experimental study, where time was the first independent variable (IV1), and condition was the second (IV2). For IV1, there were three levels; the Baseline, Stressor, and Recovery periods. The Baseline period lasted 5 minutes and both survey and physiological data were collected for analysis to establish a resting physiological and survey-reported stress state. The Stressor period lasted varying lengths, and was when each participant read the police gun violence social media post and reported their stress state afterwards. As so, both physiological and survey data was collected during this time frame for analysis. The last period of Recovery was 10 minutes, and was designated time for the participant to 'recuperate' after the Stressor period. Only physiological data was collected during this time frame.

The second independent variable was condition and had two levels; Condition 1 and Condition 2. In Condition 1, participants were asked to read the social media post on a specific incidence of police gun violence against a White victim, and depicted a photo of a White man. In Condition 2, participants were asked to read the same article, where the incidence of police gun violence was against a Black victim, and depicted a photo of a Black man. Participants were sorted into each condition randomly. There was no variation between the social media posts with the exception of different photos being used. These photos were selected from collections of stock photos by Adobe and Shopify, and were assessed for similarity in body language, photo quality, facial expressions, and framing to ensure little irrelevant variation (A Stock Studio, n.d.; Shopify, n.d.). The photos selected fit the aforementioned criteria and depict headshots of two men smiling with teeth (Appendix D).

The social media post developed for the present study was made using the generator Tweetgen and formatted as a thread posted by the Associated Press (Appendix E). Using the

Associated Press as the news outlet was favored, as this agency is regarded as neutral politically speaking. Their logo was used as the profile picture to mimic the true Associated Press Twitter account. The contents of the tweet were developed using three real stories of police gun violence and combined to ensure the manifested story wasn't recognized as false (Deliso, 2022; Jensen et al., 2022; Mark, 2022). Emotion-coded language was avoided in order to stop the induction of emotional responses based solely on trigger words.

This study used a between subject design in order to control for fatigue, where the dependent variable (DV) was emotional stress response. There were six dependent variables, two were survey measures and four were physiological features. All six variables were collected during the Baseline and Stressor periods to analyze the resulting effect of both time and condition, however for the Recovery period only the four physiological features were collected. The dependent variables were measured on a ratio scale for both survey and physiological data, IV1 was measured on an interval scale, and IV2 was measured on an ordinal scale.

The two dependent variable survey measures were the Positive Affect (PA) Measure and Negative Affect (NA) Measure. The PA measure consisted of questions asking participants to rate their current positive feelings on a scale from 0 (not at all) to 10 (extremely). These current feelings were designated a word associated with positive emotional states, such as "calm". For instance, one question gave a scale of 0 (not at all calm) to 10 (extremely calm) and the participant would rate their current feelings of calmness by selecting a numerical value. The NA measure consisted of questions asking participants to rate their current negative feelings on a scale from 0 (not at all) to 10 (extremely). These current feelings were designated a word associated with negative emotional states, such as "nervous". The Positive and Negative Affect measures were combined into one block of questions during the study for convenience (named

PA/NA), however due to the differing relationship positive and negative affect have, their data was analyzed separately. To distinguish between the PA measure data collected in the Baseline versus the same data collected in the Stressor, numbers were assigned based on the period (Baseline = PA1, Stressor = PA2). The same was done to distinguish the NA measure data, where NA1 indicates data collected in the Baseline, and NA2 indicates data collected in the Stressor period. The PA/NA question block introduced in the Baseline period contained PA1 and NA1 measures, and the block introduced in the Stressor contained PA2 and NA2 measures for both conditions. Each participant's average score in PA1, NA1, PA2, and NA2 was calculated, and recorded. It was then sorted based on the period it was taken from (Baseline or Stressor) and the condition the participant was exposed to. These extracted values were utilized in testing later to find significant differences between Baseline and Stressor periods.

The four dependent variable physiological measures were HR, HRV; low and high frequency power spectral density (P*SD*), and R-R interval. These features were collected using an electrocardiogram (ECG) machine and a program for electrophysiological data analysis, BIOPAC. To set up the ECG, two electrodes were placed on both posterior calves and one electrode on the anterior non-dominant wrist of each participant. All four features were collected by continuously recording the electrical activity of the heart throughout the study. In the BIOPAC program, this recording was automatically divided into an ECG channel and Heart Rate channel. To indicate the start of the Baseline, Stressor, and Recovery periods on the channels, a marker was placed during the study at the beginnings of each period.

Measures

State-Trait Anxiety Index

Although the State-Trait Anxiety Index (STAI) is not used explicitly in the present study, the Positive Affect Measures 1 and 2, as well as Negative Affect Measures 1 and 2 that were utilized are derivatives of the STAI. The STAI has both a "State" and "Trait" section in order to assess current feelings and overall feelings of a person's anxiety level (Spielberger et al., 1983). For the purposes of the present study, only the "State" section was assessed for usability. Though the STAI uses a 5-point Likert scale that combines items associated with positive and negative affective states, research has shown that positive and negative affect have different relationships when measured over shorter periods of time and are therefore separate predictors (Diener & Emmons, 1984). For this reason, the trigger words found in the STAI were divided up by overall positive or negative connotation and assembled into two measures; the Positive Affect Measure and Negative Affect Measure.

Despite a 5-7 point Likert scale being used in previous research, the Boateng et al., (2018) article demonstrates evidence supporting the use of a larger scale range when measuring bipolar items. Further alterations to the STAI include removing the precursor statements of "I am" and "I feel" to avoid redundancy and concentrate assessment on current feelings. Not all trigger words found in the STAI were utilized in the measures and some words were changed to synonyms to avoid repetition.

Positive Affect Measure 1 (PA1)

A 10-item self-report electronic questionnaire (Appendix B) measuring the degree to which one is feeling the following psychological states; calm, secure, relaxed, at ease, pleasant,

steady, content, comfortable, confident, and satisfied. The degree of each state falls on an 11-point scale ranging from 0 to 10, where 0 is “not at all” and 10 is “extremely”. On this scale, higher scores of 6-10 indicate elevated positive affective states in participants, whereas lower scores of 0-4 indicate diminished positive affective states, $a = 0.91$, $M = 7.443$, $SD = 0.254$.

A score of 5 is a neutral rating indicating no strong feelings of the given state. This measure was administered with NA1 to participants during the Baseline period prior to reading the social media gun violence post, in both conditions.

Positive Affect Measure 2 (PA2)

A 10-item self-report electronic questionnaire (Appendix B) measuring the degree to which one is feeling the following psychological states; calm, secure, relaxed, at ease, pleasant, steady, content, comfortable, confident, and satisfied. The degree of each state falls on an 11-point scale ranging from 0 to 10, where 0 is “not at all” and 10 is “extremely”. On this scale, higher scores of 6-10 indicate elevated positive affective states in participants, whereas lower scores of 0-4 indicate diminished positive affective states, $a = 0.94$, $M = 4.429$, $SD = 1.122$.

A score of 5 is a neutral rating indicating no strong feelings of the given state. This measure was administered with NA2 to participants during the Stressor period after reading the social media post, in both conditions.

Negative Affect Measure 1 (NA1)

A 7-item self-report electronic questionnaire (Appendix C) measuring the degree to which one is feeling the following psychological states; worried, strained, upset, frightened, nervous, jittery, and confused. The degree of each state falls on an 11-point scale ranging from 0 to 10, where 0 is “not at all” and 10 is “extremely”. On this scale, higher scores of 6-10 indicate

elevated negative affective states in participants, whereas lower scores of 0-4 indicate diminished negative affective states, $a = 0.84$, $M = 2.116$, $SD = 1.052$.

A score of 5 is a neutral rating indicating no strong feelings of the given state. This measure was administered with PA 1 to participants during the Baseline period prior to reading the social media gun violence post, in both conditions.

Negative Affect Measure 2 (NA2)

A 10-item self-report electronic questionnaire (Appendix C) measuring the degree to which one is feeling the following psychological states; worried, strained, upset, frightened, nervous, jittery, and confused. The degree of each state falls on an 11-point scale ranging from 0 to 10, where 0 is "not at all" and 10 is "extremely". On this scale, higher scores of 6-10 indicate elevated negative affective states in participants, whereas lower scores of 0-4 indicate diminished negative affective states, $a = 0.79$, $M = 4.762$, $SD = 1.292$.

A score of 5 is a neutral rating indicating no strong feelings of the given state. This measure was administered with PA2 to participants during the Stressor period after reading the social media post, in both conditions.

Demographic Measure

An online questionnaire administered on Qualtrics to collect racial/ethnic, age, and enrollment information on participants wishing to receive gift card compensation (Appendix A). This measure was administered prior to the scheduled participation slot for study.

Procedure

While recruiting participants, individuals were asked their race, ethnicity, age, and enrollment at Allegheny College. To participate in data collection for this study, participants

must be over the age of 18, identify as Latinx or non-Latinx non-Arab White. Due to the compensation participants received for participating in this study, BIPOC-identifying participants were not disqualified from registering based on their racial or ethnic identity. This means if they registered to participate, they received compensation but no data was collected or analyzed from them. The number of students recruited for this study was 27; however, 6 of these did not meet the above requirements, and therefore no data was collected from them, bringing the sample size to $n = 21$. Condition 1 contained $n = 11$ participants, whereas Condition 2 had $n = 10$.

Prior to participating in this study, participants received and signed an informed consent form to verify their ability to participate. Next, the participant was given an overview of the timeline of the study and instructed on the electrocardiogram. Then, electrodes were placed and they were asked to remove any and all jewelry or accessories in the vicinity of the to avoid any interaction with the machinery. The participants were then hooked up to the ECG for continuous monitoring and the machine was calibrated to their body. They were then given a device to both read the articles and answer the measures on their stress levels. The ECG electrodes were placed using the aforementioned system and collected in the PQRS complex.

After setup, the Baseline period started. In this period, participants were asked to sit still, relax, and keep their eyes open for the next five minutes in order to measure their resting ECG features. They were then asked to answer the first block of PA/NA questions regarding their current emotional/stress state. After answering the questions, the Stressor period started. In this period, they read a short social media post on police gun violence for their assigned condition and answered the second block of PA/NA questions. They were then instructed to relax, sit still, and keep their eyes open for the following ten minutes to collect the Recovery period data.

Finally, they were unhooked from the equipment, debriefed, and allowed to exit. Participants filled out a debrief form following being unhooked from the equipment. This form contained questions asking the type of compensation desired and if the participant wanted to receive the results of the study. Researchers monitored participants for residual stress following the experiment and offered support if needed. As previously stated, BIPOC-identifying participants will not experience said procedure, and will instead be told the physiological equipment is broken and receive their compensation.

Data Conversion

Following physiological data collection, the ECG data was analyzed briefly to extract necessary features for analysis. To do this, the Baseline, Stressor, and Recovery periods were each highlighted with a cursor between their markers to extract data from only these sections of data. In the Baseline, only the final three minutes of the total five-minute period was highlighted and used in extraction and analysis to control for any residual physiological activity induced by outside stimuli prior to the study. For the Stressor, the entire portion of this period was utilized in extraction and analysis. Finally, only the final five minutes of the ten-minute Recovery period was extracted by highlighting in order to control for residual physiological activity induced in the Stressor period. However due to time constraints, only the mean values from this period were calculated for each participant data file and no testing for significance was done.

To extract the R-R interval data, the entire ECG data channel was highlighted and the average time change between R-peaks was calculated into a new channel. To find the average R-R interval for each time period, the relevant section was highlighted between markers and set to extract a mean. For HRV, the ECG channel was highlighted and the program was prompted to calculate the Power Spectral Density (P*SD*) of the mean LF and HF band energy. P*SD* analysis is

a valued method of analysis in stress research when Trigonometric Regressive Spectral Analysis (TRS) is not accessible, as is in this case (Cohen et al., 1999; Ruediger et al., 2004). It calculates the distribution of spectral energy in a time unit, and for the present study was measured in millivolts per seconds (mV/s). The output of this calculation is in these units due to Frequency-domain analysis being preferential for short-term stress research (Kim et al., 2018). P*SD* analyses allow for assessment of both PNS and SNS energy variance overtime, where LF reflects SNS and HF reflects PNS activity (Kim et al., 2018). For this reason, LF and HF were the only extracted P*SD* values, as the very high/low frequency bands and Sympathetic-Vagal balance values have not shown to be consistently significant in analysis of HRV (Kim et al., 2018). HR was extracted by highlighting the relevant period in the Heart Rate channel and prompting the program to produce an average.

After extracting these values, they were compiled into a spreadsheet and sorted by the period they were extracted from and the condition the participant was exposed to. Then, this sheet was duplicated until each of the physiological features (HR, HRV; LF and HF, and RR Interval) were sorted into their own spreadsheets. After this, each respective physiological feature's data was divided by condition into separate spreadsheets, making sure to categorize this data internally by the period it was extracted from. This was done to run two separate Paired Sample T - Tests for each physiological feature and assess significance between periods without combining the separate condition's data. Due to time constraints, only physiological data collected in the Baseline and Stressor were analyzed; no analysis was conducted on Recovery besides a mean for each feature being calculated.

For the survey data, this same method of sorting was done after calculating the mean measure scores for each participant and sorting them by period and condition in a spreadsheet.

Essentially, separate spreadsheets were created for each measure, with a total of two spreadsheets, for PA1 and 2, and NA1 and 2. These spreadsheets were further divided by condition, for a grand total of four spreadsheets; Condition 1 – PA 1 and 2 measures, Condition 2 – PA1 and 2 measures, Condition 1 – NA1 and 2 measures, and Condition 2 – NA1 and 2 measures. This was also done to run separate Paired Sample T – Tests for each measure and assess the significance between periods without combining separate condition's data.

Reactivity

In order to examine the reactivity of participants to the Stressor period while taking into account each participant's Baseline measurement, mean differences were calculated. For the PA measure data, this was done by subtraction of PA1 from PA2 scores for each participant. This same method was used to examine reactivity in the negative affect measure as well. For physiological data, this method was continued for HR, HRV; LF and HF P*SD*, and RR Interval. These reactivity scores were sorted into two spreadsheets; one for survey scores and one for physiological feature scores, making sure to categorize scores by the measure/feature they were collected from and the condition the participant was exposed to. This was done to run Independent T-Tests and compare the reactivity scores in order to examine any potential differences between those in Condition 1 and Condition 2. This contrasts the use of Paired T-Tests run on the original extracted data to compare significant differences between the Baseline and Stressor periods.

Hypotheses

In the present study, experimental conditions were utilized to examine desensitizing effects of Whiteness and Own-race bias on physiological and reported stress responses to police gun violence social media in White people. Two hypotheses were proposed for the results and

are as follows; 1) there will be a significant increase in survey-reported and/or physiological stress measures between the Baseline and Stressor periods of measurement, and 2) these significant increases will be lesser in Condition 2 than Condition 1. Hypothesis one enables examination into whether or not the police gun violence social media post caused a stress response in participants. The null for this hypothesis was that when exposed to these posts, participants will not elicit physiological and/or reported stress responses across Baseline and Stressor periods. The experimental hypothesis for this hypothesis was that when exposed to the posts, participants will elicit significant reported and/or physiological stress responses across the Baseline and Stressor periods. For the null of hypothesis one to be rejected, the following must be significant; a) the mean scores of PA1 must show a decrease in PA2, and the mean scores of NA1 must show an increase in NA2 for both Condition 1 and 2, and/or b) the mean values of RR interval and/or High frequency band power decrease, and/or the mean values of HR and/or Low frequency band power increase across the Baseline and Stressor periods. For the null hypothesis of hypothesis one to be accepted, the majority of collected survey or physiological data must show no significant difference between the Baseline and Stressor periods.

The experimental hypothesis for hypothesis two examines if participants in Condition 2 exhibited a desensitized stress response by comparing collected physiological and survey data to Condition 1, and is as follows; participants showed a significant reduction in survey-reported and/or physiological stress responses in Condition 2 as compared to participants in Condition 1 between the Baseline and Stressor periods. The null for this hypothesis was that participants did not show a significant reduction in survey-reported and/or physiological stress responses in Condition 2 as compared to participants in Condition 1 between the Baseline and Stressor periods. For the null for this hypothesis to be rejected, the following must be significant; a) the

PA reactivity score is reduced in Condition 2 as compared to Condition 1, and the NA reactivity score is reduced in Condition 2 as compared to Condition 1. In continuation, to reject the null the following must be significant for the physiological data; b) the reactivity score for physiological features must be smaller in Condition 2 as compared to Condition 1. For the RR interval, the score must show a smaller decrease, for HR it must show a smaller increase, and for HRV they must show a smaller increase in LF band power and smaller decrease in HF band power.

Results

Relevant Values and Regions

According to Tavakol & Dennick (2011), alpha (*a*) ranges between 0.70 – 0.95 indicate acceptable reliability. As the calculated alphas fall into this range of values, all survey measures were regarded as reliable in this study. In both Paired and Independent Sample T-Tests, p values less than 0.05 fall into the rejection region and indicate significant findings in the data. Effect size indicates the size of the difference between two comparison groups, and is represented by Cohen's *d* value. For the effect size, *d* values of around 0.20 equate a small difference between the groups, whereas $d = .0.50$ and $d \geq 0.80$ indicate medium and large group differences respectively (Sullivan & Feinn, 2012). Shapiro-Wilk's Test of Normality utilizes *p* values as well, and measures the likelihood that the sampled data is normally distributed. For this test, $p < 0.05$ indicates significant violations to the assumption that the data falls in a normal distribution pattern.

Significance Between Baseline and Stressor

Survey Data

For all survey data, results from Paired Sample T-Tests showed a significant change in PA and NA scores across the Baseline and Stressor periods for both conditions. Furthermore, effect size analyses found there to be a large effect of IV1 on the scores of participants on both the PA and NA measures. However, a Shapiro-Wilk's analysis run found a violation to the assumption of normally distributed data for Condition 1's NA scores. A summarized table of values and findings can be found in Table 1.

Table 1

Average Survey Measure Extracted Scores by Period and Condition

Survey Measure	Period	Condition	N	Mean	*SD*
Positive Affect Measure	Baseline	1°±	10	7.900	0.876
	Stressor		10	4.700	1.703
	Baseline	2°±	11	7.091	1.700
	Stressor		11	4.273	1.902
Negative Affect Measure	Stressor	1°±*	10	4.200	1.751
	Baseline		10	1.600	1.647
	Stressor	2°±	11	5.182	1.471
	Baseline		11	2.727	1.489

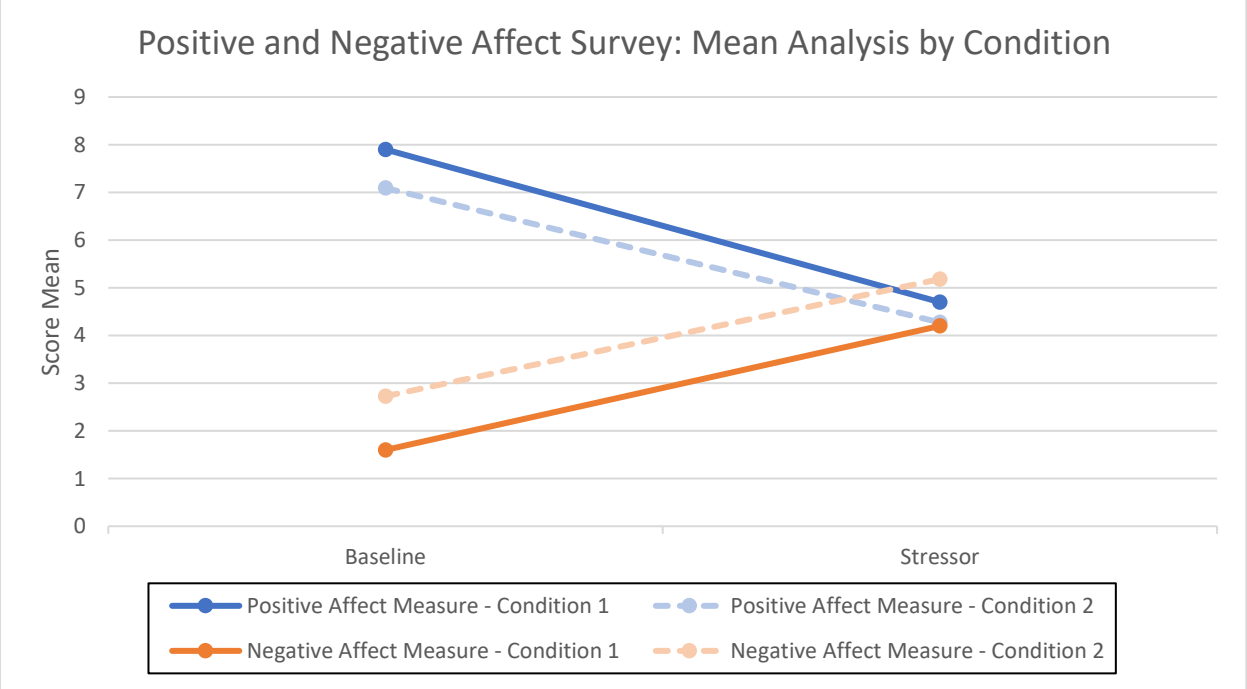
*1 Note: * = normality violation ($p < 0.05$); ° = significant difference ($p < 0.05$); ± = large effect size ($d \geq 0.80$)*

Significant differences in PA scores between the Baseline ($M = 7.900$, $SD = 0.876$) and Stressor ($M = 4.700$, $SD = 1.703$) periods was found for Condition 1 (t [9] = 6.000, $p < .001$). Condition 2 PA scores between the Baseline ($M = 7.091$, $SD = 1.700$) and Stressor ($M = 4.273$, $SD = 1.902$) periods were also found to be significant, t [10] = 5.622, $p < .001$. For Condition 1 PA scores, the effect size was found to be large ($d = 1.897$) based on levels set by Cohen (1988). The data was also found to be normally distributed based on the results of a Shapiro-Wilk's analysis, $p = 0.118$. For Condition 2 PA scores, the effect size was found to be large ($d = 1.695$) and a Shapiro-Wilk's test revealed no violations to the assumption of normality, $p = 0.250$ (Cohen, 1988). A Paired T-Test analysis on NA scores between the Baseline ($M = 1.600$, $SD =$

1.647) and Stressor (M = 4.200, SD = 1.751) periods also showed significance in Condition 1, t [9] = 5.212, p < .001. NA scores in Condition 2 also showed significance between the Baseline (M = 2.727, SD = 1.489) and Stressor (M = 5.182, SD = 1.471) periods, t [10] = 5.177, p < .001. The effect size of the Condition 1 NA score difference was found to be large (d = 1.648) based on aforementioned levels, however a Shapiro-Wilk's analysis concluded that the data violated the assumption of normal distribution (p = 0.042) (Cohen, 1988). For Condition 2 NA scores, an effect size analysis found a large effect (d = 1.561), and a Shapiro-Wilk's analysis found no normality assumption violations, p = 0.557). Figure 1 shows the summarized survey data collected for both Positive and Negative Affect measures and is categorized by Baseline and Stressor score means.

Figure 1

Positive and Negative Affect Surveys: Mean Analysis by Condition



Physiological Data

For all physiological data collected, there were no significant differences found between the Baseline and Stressor periods. Furthermore, Shapiro-Wilk's test results indicated the data for most features violated the assumption of normality, meaning the data was not normally distributed. The extracted data means calculated for each period can be found in Table 2.

Table 2

Average Physiological Feature Scores by Period and Condition

Physiological Measure	Condition	Period	N	Mean	*SD*
Heart Rate	1	Baseline	10	85.566	14.085
		Stressor	9	83.063	15.280
Heart Rate	2*	Stressor	11	98.489	43.959
		Baseline	11	79.209	16.965
Low Frequency HRV	1*	Baseline	10	0.017	0.053
		Stressor	9	0.004	0.009
Low Frequency HRV	2*	Baseline	11	0.057	0.178
		Stressor	11	0.146	0.197
High Frequency HRV	1*	Baseline	10	0.026	0.080
		Stressor	9	0.845	2.516
High Frequency HRV	2*	Baseline	11	0.010	0.022
		Stressor	11	0.054	0.092
R-R Interval	2*	Baseline	11	1.047	0.710
		Stressor	11	1.059	0.613
R-R Interval	1	Baseline	10	1.384	0.791
		Stressor	9	1.344	0.687

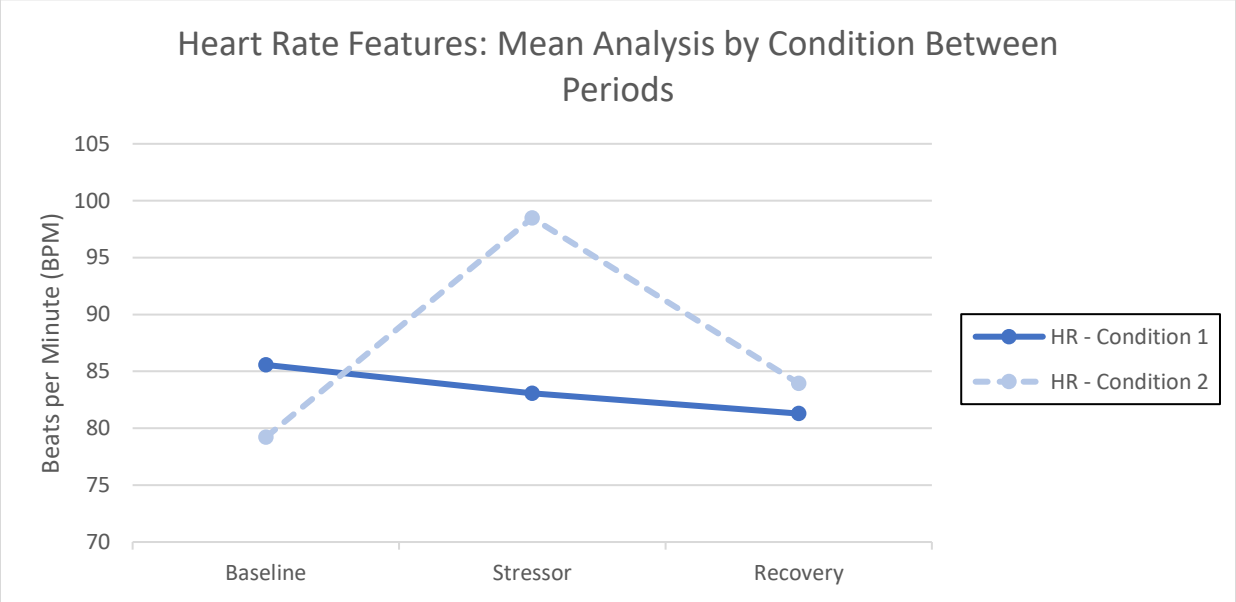
*1 Note: * = normality violation ($p < 0.05$); ° = significant difference ($p < 0.05$); ± = large effect size ($d \geq 0.80$)*

For HR analysis, Paired-T-Tests were conducted for Condition 1 and revealed no significant difference between the Baseline (M = 85.566, SD = 14.085) and Stressor (M = 83.063, SD = 15.280) periods, t (10) = 1.426, p = 0.184. Shapiro-Wilk's test revealed no violation to the assumption of normality (p = 0.083). For the Paired T-Test analysis of HR for Condition 2, no significant difference between the Baseline (M = 79.209, SD = 16.965) and

Stressor (M = 98.489, SD = 43.959) periods was found, t (8) = 1.611, p = 0.146. In addition, Shapiro-Wilks revealed a violation of normality (p < .001). Figure 2 depicts a summarized graph of the means for the Baseline, Stressor, and Recovery periods sorted by condition. As shown, there is a clear visual demonstrating a large difference in the Stressor HR data for Condition 2, so a larger sample size may have revealed significance in this data. Furthermore, all the data would benefit from a larger sample size to increase the chances of having normally distributed data and reduce the chance of a violation detected by Shapiro-Wilk's test.

Figure 2

Heart Rate Features: Mean Analysis by Condition Between Periods

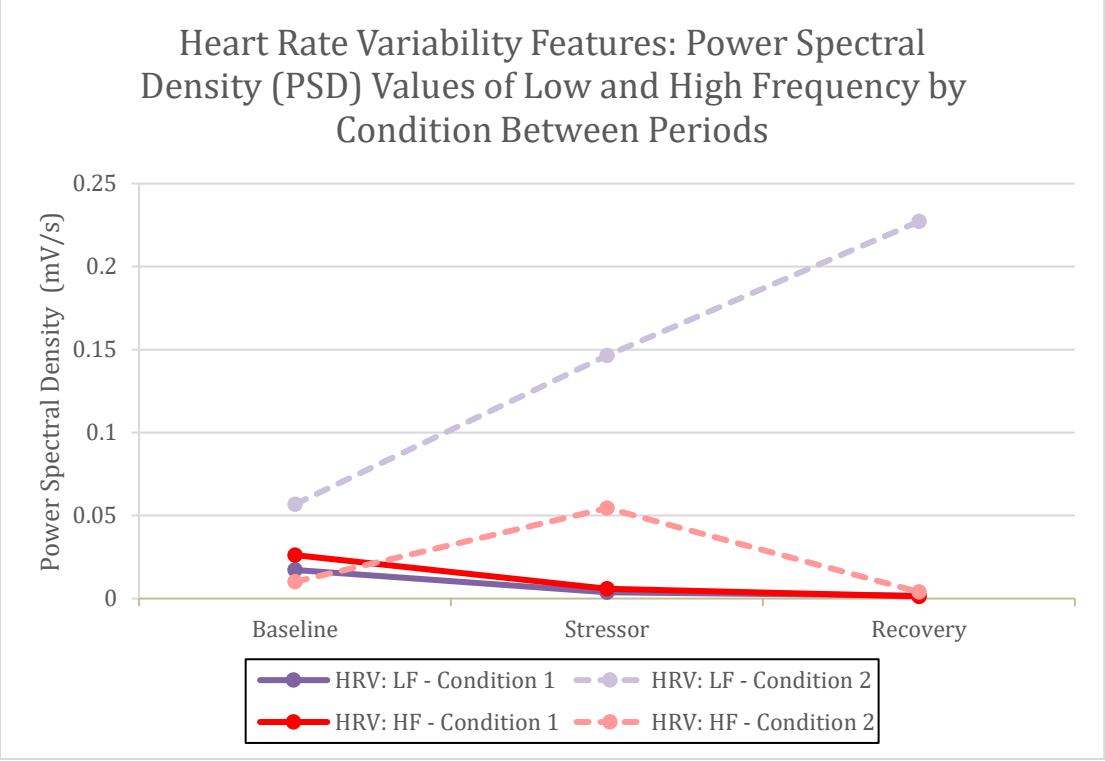


For HRV, A Paired T-Test was conducted for Condition 1 on LF PSD values, and revealed no significant difference between the Baseline (M = 0.017, SD = 0.053) and Stressor (M = 0.004, SD = 0.009) periods, t (8) = 0.801, p = 0.446. This same Condition 1 T-Test on HF PSD values revealed no significant difference between the Baseline (M = 0.026, SD = 0.080) and Stressor (M = 0.845, SD = 2.516) periods, t (8) = -0.968, p = 0.362. A Shapiro-Wilk Test demonstrated significant violations to the assumptions of normality for PSD of HF (p < .001) and

P*SD* of LF ($p < .001$). A second Paired T-Test on Condition 2's HF P*SD* values revealed no significant differences between the Baseline ($M = 0.010$, $SD = 0.022$) and Stressor ($M = 0.054$, $SD = 0.092$) periods, $t\ (10) = -1.062$, $p = 0.313$. Furthermore, no significant differences in the LF P*SD* values were found between the Baseline ($M = 0.057$, $SD = 0.178$) and Stressor ($M = 0.146$, $SD = 0.197$) periods, $t\ (10) = -1.523$, $p = 0.159$. Shapiro-Wilks Tests on the assumptions of normality revealed violations for HF ($p < .001$) and LF, $p = 0.040$. A graphical summary of mean HRV frequency P*SD* values can be found in Figure 3.

Figure 3

Heart Rate Variability Features: Power Spectral Density (PSD) Analysis of Low and High Frequency by Condition



A Paired Sample T-Test of RR Interval for Condition 1 revealed no significant differences between Baseline ($M = 1.384$, $SD = 0.791$) and Stressor periods ($M = 1.344$, 0.687), $t\ (8) = 1.541$, $p = 0.162$. A Shapiro-Wilk's test was run and concluded no violation to the

normality assumptions, $p = 0.793$. For Condition 2, no significant difference was found between the Baseline ($M = 1.047$, $SD = 0.710$) and Stressor ($M = 1.059$, $SD = 0.613$) periods, $t\ (10) = -0.104$, $p = 0.919$. A Shapiro-Wilk's test of normality determined that the data violated the assumption of normal distribution ($p = 0.010$). A summarized diagram of RR Interval means can be found in Figure 4. In addition, to visualize all physiological data a graphical summary was created, and can be found in Figure 5.

Figure 4

R-R Interval Features: Mean Analysis by Condition Between Periods

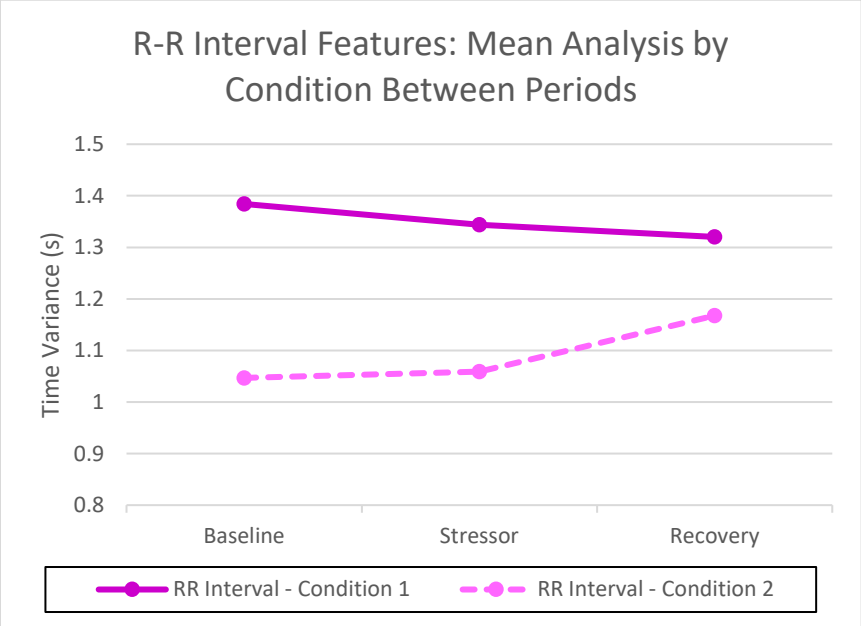
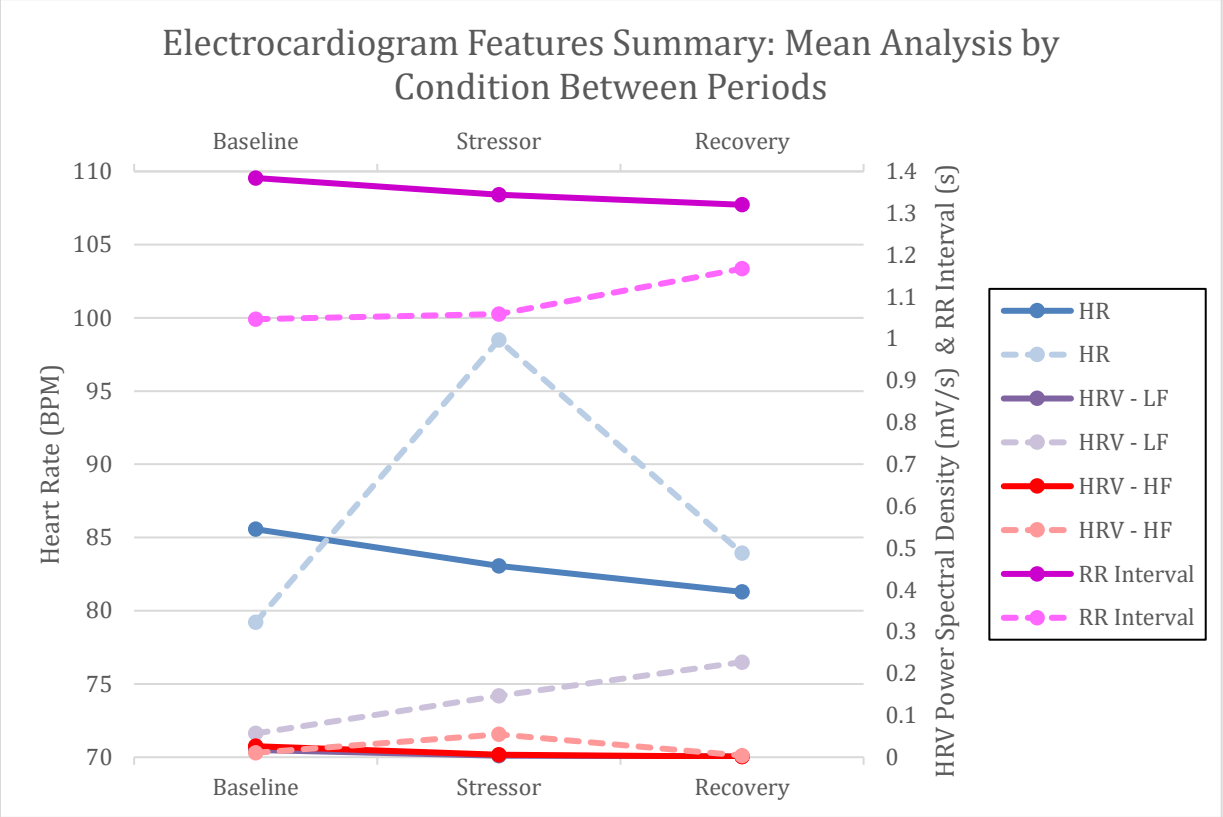


Figure 5

Electrocardiogram Features Summary: Mean Analysis by Condition Between Periods



1 Note: Solid lines indicate Condition 1 data, stripped lines indicate Condition 2

Significance Between Conditions

Survey Data

To examine hypothesis two, reactivity scores were calculated by subtraction of the Baseline value from the Stressor for each physiological feature extracted. These differences were then run through an Independent Sample T-Test to determine any significant differences in mean scores between conditions. These tests revealed no significance between conditions for PA or NA scores. Furthermore, a Shapiro-Wilk's test on Condition 1 NA scores found a violation to the assumption of normality. These findings and values can be found in Table 3.

Table 3

Average Reactivity Scores for Survey Measures by Condition

Survey Measure	Condition	N	Mean	*SD*
Positive Affect Reactivity Score	1	10	-3.200	1.687
	2	11	-2.818	1.662
Negative Affect Reactivity Score	1*	10	2.600	1.578
	2	11	2.455	1.572

*2 Note: * = normality violation ($p < 0.05$); ° = significant difference ($p < 0.05$); ± = large effect size ($d \geq 0.80$)*

Results from an Independent T-Test revealed no significant changes between Condition 1 PA scores (M = -3.200, SD = 1.687) and Condition 2 PA scores (M = -2.818, SD = 1.662), t [19] = -0.522, p = 0.608. A Shapiro-Wilk's Test found PA mean differences to be normally distributed for Conditions 1 (p = 0.118) and 2 (p = 0.250). A second Independent T-Test found no significant differences between Condition 1 (M = 2.600, SD = 1.578) and Condition 2 (M = 2.455, SD = 1.572) NA reactivity scores, t (19) = 0.211, p = 0.835. Furthermore, a Shapiro-Wilk's analysis run on the mean reactivity scores for NA measures taken in Condition 1 revealed a significant violation to the assumption of normality (p = 0.042), however no such violation was found in Condition 2 (p = 0.557).

Physiological Data

For the reactivity scores calculated, an Independent T-Test was conducted to determine significance between each condition for each physiological feature. Of these T-Tests, none found significant differences between Condition 1 and Condition 2. Furthermore, the results of a Shapiro-Wilk's test found that most of the data sets exhibited violations to the assumption of normality. These data sets can be found in Table 4.

Table 4

Average Reactivity Scores for Physiological Features by Condition

Physiological Feature	Condition	N	Mean	*SD*
Heart Rate	1	9	-4.017	7.477
	2*	11	19.280	44.837
Low Frequency HRV	1*	10	-0.014	0.054
	2*	11	0.090	0.280
High Frequency HRV	1*	10	0.734	2.398
	2*	11	0.044	0.096
R-R Interval	1	10	-0.175	0.279
	2*	11	0.012	0.387

*1 Note: * = normality violation ($p < 0.05$); ° = significant difference ($p < 0.05$); ± = large effect size ($d \geq 0.80$)*

An Independent T-Test on mean reactivity scores of HR between Condition 1 (M = -4.017, SD = 7.477) and Condition 2 (M = 19.280, SD = 44.837) showed no significant differences, t (18) = 1.534, p = 0.142. Furthermore, Shapiro-Wilk's test showed a violation in normal distribution for Condition 2 ($p < .001$), however no violation in Condition 1, p = 0.083.

An Independent T-Test comparing reactivity scores in LF and HF for HRV revealed no significant differences in any scores between conditions. For LF scores, no significance was found between Condition 1 (M = -0.014, SD = 0.054) and Condition 2 (M = 0.090, SD = 0.280) differences, t (19) = -1.147, p = 0.266. It also revealed no significant differences in HF between Condition 1 (M = 0.734, SD = 2.398) and Condition 2 (M = 0.044, SD = 0.096), t (19) = 0.956, p = 0.351. Further Shapiro-Wilks Tests revealed violations to normality assumptions in HF ($p < .001$) and LF ($p < .001$) for Condition 1, as well as HF ($p < .001$) and LF (p = 0.040) for Condition 2.

An Independent Sample T-Test of RR reactivity score was run to compare both conditions and found no significant differences between Condition 1 (M = -0.175, SD = 0.279) and Condition 2 (M = 0.012, SD = 0.387), t (19) = -1.257, p = 0.224. Furthermore, a Shapiro-

Wilk's test detected a violation in normality for Condition 2's mean differences ($p = 0.010$), however did not detect a violation in Condition 1 ($p = 0.806$).

Discussion

In the present study, a 3x2 factorial experimental design was utilized to test for significant differences in reported and physiological stress when participants were exposed to police gun violence media. Participants were randomly sorted into two conditions; Condition 1, where the media contained a photo of a white man, and Condition 2, containing a photo of a Black man. Physiological data was collected in the Baseline, Stressor, and Recovery periods, whereas survey-reported stress responses were collected in the Baseline and Stressor periods only. Significance analyses were conducted using Paired T-Tests on the time variable, whereas Independent T-Tests were used on reactivity scores to determine significance between condition.

Findings Between Periods and Future Directions

To measure stress, Positive and Negative Affect measures were created from the STAI and utilized in combination with physiological feature collection. The PA and NA measures were divided by period (Baseline or Stressor), for four total measures used in analysis. After collecting survey data, significance was found between periods for both PA and NA survey measures in both conditions. This indicates that there was a difference in reported stress responses after reading the police gun violence social media post, supporting rejection of the null for hypothesis one. Analyses conducted on these results found that this difference was large, however a Shapiro-Wilk's test found that the data collected using the Negative Affect measure in Condition 1 violated the assumption of being normally distributed. No other measures in either condition was found to violate this assumption, meaning there was no found issue with the sample

distribution. When looking at the size of samples for both Condition 1 (n = 10) and Condition 2 (n = 11), it is clear that the poor distribution of affective scores is due to a sampling error. Since the sample of participants from Allegheny College was such a small number in comparison to the overall population of the College, the likelihood that the data collected would be representative of the population is small. This is because the more data collected increases the chance of the scores falling into a bell curve shape characteristic of ideal, randomly-sampled data.

Furthermore, this issue of normality violations was found in the physiological data as well. The features collected during the Baseline, Stressor, and Recovery periods were HR, HRV; LF and HF, and R-R Interval using an electrocardiogram. Analyses using a Paired T-Test revealed no significant differences between the Baseline and Stressor periods for any of the features collected. This indicates that after exposure to the police gun violence article, there was no evidence of a physiological stress response in participants. Furthermore, Shapiro-Wilk's analyses on each feature found violations of normality for all data collected with the exception of HR and R-R Interval data in Condition 1 (See Table 2). These findings support the theory of small sample size being responsible for the normality violations found. Additionally, one participant's data in Condition 1 consisted of irregular values outside the usual range for every physiological feature in the Stressor period, and was therefore excluded prior to analysis. As the Stressor period was after the Baseline, it is possible there was an issue with electrode attachment that persisted as time went on however this is unconfirmed. This exclusion brought the sample size down to n = 9 for the Stressor period of Condition 1, likely reinforcing the chances of irregular data distribution.

One physiological feature collected during the study, heart rate, was not found to experience significant changes between the periods. Despite this, after visualizing the data in graphical format, it is clear there is a large jump in heart rate in the Stressor period of Condition 2 (See Figure 5). This may be due to outliers, as the standard deviation from the mean for this data is large (*SD* = 43.959). However, it may also be due to a combined effect of the previously-established small sample size with outliers. Because of this, there may have been a physiological stress response in the form of heart rate. Repeating this study with a larger sample size and thorough assessment for outliers should be conducted in order to reevaluate heart rate differences between periods. In addition, heart rate has consistently been shown to be significantly affected in acute stress research, so retesting this feature with a more representative sample may refute the results found in this study.

When examining the other physiological features, there didn't seem to be any issues with outliers or the calculated standard deviation, with the exception of the P*SD* values for HRV. In several of the P*SD* values, the standard deviation is two to three times that of the mean, and falls outside the range of usual values for that frequency. This indicates an issue with sensitivity, possibly caused by the electrodes picking up interference or there being lots of affect present in the HRV frequency values before power spectral density analyses were run. In Li et al (2019), authors found several alternative tools useful for analyzing data collected over a short time, such as Trigonometric Regressive Spectral Analysis (TRS). TRS is not as easily accessible as P*SD*, however demonstrates higher reliability in shorter time frames, such as the Stressor period in the present study (Ruediger et al., 2004). For this reason, other methods of analyzing HRV data such as TRS usage should be utilized when analyzing future study results with the aforementioned corrections.

A curious finding of this study is that although both survey measures reported significant differences between periods in both conditions, none of the physiological features did. This may be due to the police gun violence media article not being enough to elicit a physiological stress response. Research on stress responses to violent media has been conducted, however the popular measures for this research are survey or interviewing formats instead of physiological measures, such as in Bauldry & Stainback (2022) and He et al. (2021) and their assessments of psychological and acute stress in response to COVID-19 media. As both psychological and physiological stress in both acute and chronic frequencies are commonly tied to poor health outcomes, it is promising that the form of media present in this study did not elicit either of these responses in participants (Schneiderman et al., 2015). However, this finding should be retested in future research to confirm or refute the present study's conclusions. Furthermore, this study only examined White, College-aged populations, and future research should examine BIPOC responses to this media, since BIPOC people are the ones who experience the disproportionate threat of police violence (*2017 Police Violence Report, 2017*). There is a concern that BIPOC participants in this type of study may be more likely to experience adverse responses, so measures should be taken to ensure these participants are put at no more than minimal risk. This increased risk of adverse responses is supported by investigations done into the experiences of those who have witnessed police gun violence. These studies have shown this kind of exposure has adverse effects on mental health in Black populations (Bor et al., 2018). Conducting research into police violence media and the possibility of adverse effects may lead to discoveries that would inform language or picture/video choices when media outlets are reporting on these instances of violence. For example, in the murder of George Floyd, videos of him in his last moments circulated the internet, despite concerns about their graphic nature (O'Neal, 2020). It

may also provide a basis for increased support in these communities following an instance of police gun violence.

Though the present study is not aimed at addressing acute stress responses, there is a general lack of physiological methods used when studying this topic. Primarily, survey measures are used in favor of physiological ones to assess acute stress. This contrasts the definition of acute stress, which is characterized by a series of psychological or physiological reactions triggered by a traumatic or stressful life event (He et al., 2021). In order to better understand the relationship between media and physiological stress responses, further investigations should be done with the current and with new physiological features.

Lastly, since there was no difference in physiological features found but there was with survey measure, there is the possibility of response bias among the participants. This bias may be due to the participants responding to the survey in the way they think is socially acceptable, instead of honestly. If the participants were able to decipher what the study was assessing despite diversion techniques, they would want to respond in a way that makes them seem sensitive to the issues at hand. If their responses implicated that they did not care about the person in the media posts, this could cause social isolation if their responses were not anonymous. This study utilized confidential encryption of each participant's data; however, it may be beneficial in future research to utilize anonymous methods in order to encourage the most honest answers from participants.

Findings Between Conditions and Future Directions

To examine the hypothesis that there would be a difference in physiological and reported stress responses between Conditions 1 and 2, reactivity scores were calculated. These scores were isolated by subtracting the Baseline score from Stressor for each participant for each survey

and physiological measure. An Independent T-Test was then conducted to compare the reactivity scores between conditions.

For the survey measures, no significant differences were found in reactivity scores between conditions for both the PA and NA measures. This indicates there was no difference in reported stress levels for participants exposed to the White man-depicting media or the Black-man depicting one and the null hypothesis should be accepted for survey measures. The implications of this finding support that in White people, they do not experience a desensitized stress response to reading about Black people experiencing police gun violence. In continuation with this finding, it also implies they do not experience heightened responses to those of their own race experience this form of violence; indicating no effect of the own-race bias or reactivity. These findings indirectly contrast those found in Marsh et al. (2021), which specifically studies eye tracking and own-race bias. To better understand the relationship between own-race bias and police gun violence media responses, it may be key to include this physiological measure during assessment of stress. There was also an issue with normal distribution of data in the NA measure of Condition 1, however this is likely the same violation found in the Shapiro-Wilk's test done between periods for the same measure.

In physiological data analysis between conditions, Independent T-Tests found no significance between conditions for any of the physiological features. This points to participants not experiencing a difference in stress levels when reading the post depicting a White man or Black man. The same conclusion drawn from the survey data can be applied to this data as well; the findings of this study support accepting the null for hypothesis two.

In future research conducted with a larger sample size, it is essential to utilize a Factorial ANOVA to analyze data collected if using the same 3x2 experimental formatting. Due to the

small population of participants that engaged in the present research, t-tests were favored, however for ease of analysis and efficiency, ANOVAs should be used.

Since the results of this hypothesis testing concluded no effect of race on stress responses, it may be of interest to investigate media responses with different racial and ethnic populations. As such, there is little research conducted between BIPOC populations (ie. Differences between Black and Native American people), and if done it may show similar responses between the groups since both populations experience racial stress. This could be informative as it would establish that one could experience racial stress even if their respective racial group is not the target of the stressor. These racial differences would be utilized in both the photos selected from the post as well as the populations sampled from. The same aforementioned alterations should still be utilized in this continued examination.

Though the present study opted to use Twitter formatting to create the Stressor post, a news article may elicit different results. This is because news websites are largely the more reliable sources for information, since social media platforms such as Facebook have incurred backlash due to its lack of fact-checking in advertisements (Chow, 2020). Using an online new article format may increase the level of authenticity participants register when initially viewing the content; affecting their stress responses.

Limitations

Due to the limited time frame for data analysis, no recovery data was able to be analyzed with the exception of mean values being calculated for graphical representations. These means were calculated from highlighting the final five minutes of physiological recovery data and isolating a mean value for each feature. Originally, comparisons and significance analyses would have been conducted between the Recovery and Stressor periods as well as the Baseline and

Stressor periods. This is due to research showing that when experiencing stress, there can be a greater amount of time needed to return to Baseline levels than if stressors were less intense or absent (Dhabhar, 2018). If time had allowed, it may have been informative assessing significance between physiological values taken in these time frames using Paired T-Test analysis as well as reactivity scores and Independent T-Test analysis. Additionally, future studies could opt to take a survey measurement at this five-minute marker in the recovery period to determine if participants reported stress levels similar to the Baseline.

Issues with sample distribution are evident in the findings of this study, however even with extended time for data collection it is likely that this would not isolate the root problem; that data collected from Allegheny students is not representative of White people as a whole. Even with extended time allowing for larger sample sizes and normal distribution of data, the population being sampled from is only made up of young, wealthy, primarily left-leaning College students. When looking at the demographics of the data collected in the present study, there is no information on the gender, economic status, age, or political party of the individuals in each condition; giving no indication of any other factors that could affect survey responses or physiological data. To collect the most representative sample data, the population should have gender, age, economic, and political distributions similar to that of the US's White population. Furthermore, this information should be recorded for each participant and be assessed in analysis. In continuation, sampling from a population similar to that of Allegheny College with the exception of political party may result in different findings when conducting future research on college students.

Physiological Measurement Methods

To further assess if police gun violence media elicits physiological stress responses in the body, there are several popular measurement tolls besides ECG that have been shown to be reliable in acute stress research. Though heart rate analysis did not show significant difference between periods nor between conditions in the present study, a large increase was observed in BPM between Condition 1 and 2 in Figures 2 and 5. For this reason, it may be beneficial to repeat the current study's methodology with previously outlined corrections to determine if a larger sample size would allow for significant changes between conditions or periods to be found. Other physiological features or technology that could be utilized include blood pressure, eye-tracking, and EEG wave activity.

As previously mentioned, the four pathways of stress have been used as a starting point for stress measurement in related research. When looking at other physiological measurements to collect in future research on the topic of stress responses to police gun violence, it is key to take into account these pathways; Neurohypophysis activation, Hypothalamic-pituitary-adrenal (HPA) axis activation, Sympathoadrenal system activation, and Nervous system activation. Three of the four pathways were assessed in the present study however in order to examine Neurohypophysis activation, blood pressure monitoring or eye tracking should be conducted. The most popular and accurate blood pressure features are Blood Volume Pressure/Pulse (BVP) and Blood Pressure (BP) itself (Karthikeyan et al., 2011). A 2011 review paper examined 11 different papers that assessed varied stress responses using several kinds of psychological methods (Karthikeyan et al., 2011). Of these papers, seven of them utilized BP as a physiological stress marker and six of the seven found that both systolic and diastolic BP increased significantly during the stressor condition (Karthikeyan et al., 2011). In addition to this review, several other physiological stress measurement papers reaffirmed the popularity and accuracy of

BP as a stress indicator (Arza et al., 2018; Giakoumis et al., 2013). BVP is most commonly collected with a pulse photoplethysmography (PPG), however research has shown it can be calculated accurately using ECG markers such as the QRS complex and demonstrates reliability in physiological stress research (Arza et al., 2018; Egger et al., 2019). Two features of BVP, Pulse Transit Time (PTT) and Pulse wave rising time (PRT), showed significance in acute mental stress research as well, and should be utilized in future research.

A second method for assessing Neurohypophysis pathway activation is eye-tracking. This link has been explored in recognition bias research, however could be explored in own-race bias research in a way not previously examined. The Neurohypophysis (pars posterior) is the posterior portion of the pituitary gland, and regulates oxytocin and vasopressin secretion (Santos Fontanez & De Jesus, 2022). The relation of this structure to eye movement is relative to oxytocin, which facilitates "…attentional bias towards the eye region of familiar faces, which convey safety and support, especially in anxious contexts." (Marsh et al., 2021). Since the own-race bias is based on the heightened ability to recognize faces belonging to racial in-group members, it may be linked to feelings of safety and familiarity shown in these attentional bias findings (Marsh et al., 2021). Despite this, recent research has shown caveats when analyzing emotion recognition/detection using eye tracking technology. When used alone, eye tracking does not result in high accuracies as it is a new method in the field of emotion recognition. However, when used in combination with electroencephalographs (EEGs), electrooculography's (EOGs), and galvanic skin response (GSRs), it is accuracy can increase. EEGs are used to measure electrical activity in the brain, EOGs measure eye movement dependent electrical activity, and GSRs measure activity in sweat glands using electrical signaling (Mayo Clinic Staff, 2018; Belkhiria & Peysakhovich, 2020; Johns Hopkins Medicine,

2019; Nagai et al., 2019). Some examples of emotional responses measured by eye-tracking and physiological technology include pupil diameter, electrical activity in the eye muscle, speed of eye movement, and fixation time of eyes. There are also several measurements used to analyze data collected both from eye tracking machines and other physiological technology. Some examples are differential asymmetry, differential entropy, and rational asymmetry which are used in analyzing EEG, EOG, and GSR wave data. Differential asymmetry asses the differences in entropy between the two hemispheres, whereas differential entropy measures the level of uncertainty of frequency variations in wave data. Lastly, rational asymmetry measures the uncertainty of the differential asymmetry readings (Lim et al., 2020). Another technology that has a high level of accuracy when detecting emotion recognition was artificial neural networks (ANNs), which are essentially computing systems acting as artificial neurons (Park & Lek, 2016). This research shows that eye tracking alone is not an accurate or precise way of measuring emotional responses, however when combined with physiological responses it can be quite reliable (Lim et al., 2020).

In reviewing physiological emotion detection methods, the EEG was discussed as another source of measurement for research into the present topic. To measure emotions or stress responses, EEGs focus on measuring a reduction of 8-13 Hz activity (alpha wave) using high density electrodes as an indicator of an emotional response. There is also evidence of EEGs measuring asymmetrical brain activity to asses for emotional responses. This is due to asymmetrical electrical activity in the frontal region being indicative of mediating behaviors and emotional responses. Also, greater right hemisphere activation is associated with greater negative emotional responses to negative stimuli than greater right hemisphere activation (Niemic, 2004). These oscillations should be collected from the frontal and temporal regions of the brain, and

categorized by valence and arousal in the wave forms. Valence is measured by the amplitude of a brain wave, and an emotion's amplitude/valence is associated with how pleasant or unpleasant this emotion is (high valence emotions are more positive, low valence emotions are more negative). Arousal is measured by the frequency of brain wave, and an emotion's arousal/frequency is correlated with how exciting an emotion is (high arousal emotions are more exciting, low arousal emotions are less so). There are four categories EEG data is classified into using these categories; high valence/high arousal, high valence/low arousal, low valence/high arousal, and low valence/low arousal. This method of classification is frequently used to categorize collected waves into different emotional states (Gao et al., 2019; Joshi & Ghongade, 2021; Gao et al., 2020). The waves commonly associated with stress states are Alpha waves (7 - 13 Hz) and Beta waves (14 – 30 Hz). Increased Alpha wave activity is indicative of being calm and relaxed, whereas Beta wave activity is correlated with being awake and alert. Both wave measurements can produce insight into an individual's emotional response, particularly a reduction in Alpha wave activity when an emotion-inducing stimulus is applied (Niemic, 2004).

Conclusions

The findings in this study uphold the continued evidence that violent media elicits stress responses after reading. Furthermore, this study provides evidence that White people experience stress responses to police gun violence media depicting both a White and Black victim, contradicting related findings in witnessing police gun violence (Bor et al., 2018). Implications of these findings support further research using more representative populations to better understand the relationship between stress and police gun violence media in other demographics. In addition, the conclusions drawn from this study are pertinent when considering the long-term

stress effects of continued exposure to police gun violence on social media, since impacts on health have been found.

Appendices

Appendix A – Eligibility Questions

1. What is your first and last name?
2. How old are you?
    a. 17 years old or younger
    b. 18 years old or older
3. Are you a currently enrolled Allegheny student?
    a. Yes
    b. No
4. Please select one or more of the following racial groups in which you consider yourself to be a member.
    a. Asian or Asian American
    b. Black or African American
    c. Native American or Alaska Native
    d. Native Hawaiian or other Pacific Islander
    e. White, Caucasian American, or Euro-American
    f. Multiracial: Please Specify Below
        i. _____
    g. Other: Please Specify Below
        i. _____
5. Do you identify as Latinx/o/a or Hispanic?
    a. Yes, I identify as Latinx/o/a or Hispanic
    b. No, I do not identify with either of these groups.

6. Are you of Arab, North African, or Middle Eastern descent?
    a. Yes
    b. No

Appendix B – Positive Affect Measure

Please complete the following items regarding how you are feeling at the moment:

Not at all calm — Extremely calm

0 1 2 3 4 5 6 7 8 9 10

Not at all secure — Extremely secure

0 1 2 3 4 5 6 7 8 9 10

Not at all relaxed — Extremely relaxed

0 1 2 3 4 5 6 7 8 9 10

Not at all at ease — Extremely at ease

0 1 2 3 4 5 6 7 8 9 10

Not at all pleasant — Extremely pleasant

0 1 2 3 4 5 6 7 8 9 10

Not at all steady — Extremely steady

0 1 2 3 4 5 6 7 8 9 10

Not at all content — Extremely content

0 1 2 3 4 5 6 7 8 9 10

Not at all comfortable — Extremely comfortable

0 1 2 3 4 5 6 7 8 9 10

Not at all confident — Extremely confident

0 1 2 3 4 5 6 7 8 9 10

Not at all satisfied — Extremely satisfied

0 1 2 3 4 5 6 7 8 9 10

Appendix C – Negative Affect Measure

Please complete the following items regarding how you are feeling at the moment:

Not at all worried — Extremely worried

0 1 2 3 4 5 6 7 8 9 10

Not at all strained — Extremely strained

0 1 2 3 4 5 6 7 8 9 10

Not at all upset — Extremely upset

0 1 2 3 4 5 6 7 8 9 10

Not at all frightened — Extremely frightened

0 1 2 3 4 5 6 7 8 9 10

Not at all nervous — Extremely nervous

0 1 2 3 4 5 6 7 8 9 10

Not at all jittery — Extremely jittery

0 1 2 3 4 5 6 7 8 9 10

Not at all confused — Extremely confused

0 1 2 3 4 5 6 7 8 9 10

Appendix D – Photos Used





Appendix E - Twitter Posts



The Associated Press @AP · Nov 9, 2021

Derrick Anderson, a 25-year old accountant with no criminal history, was involved in a fatal shooting on the Washington Parkway on Sunday evening, after being pulled over by a Baltimore Police officer.



101 254 4.2K

The Associated Press @AP · Nov 9, 2021

According to body camera footage from the incident, the officer was approaching Anderson's car when the driver's side door opened and Anderson stepped out, asking "What am I being stopped for?". The officer responded "Stay in the car." and asked to see Anderson's driver's license.

28 93 1.6K

The Associated Press @AP · Nov 9, 2021

After briefly speaking to the passenger in his car, Anderson closed the door and took a few steps sideways, with his back turned to the officer. This is when the officer, whom authorities have not named, grabbed Anderson and began arguing with him.

34 91 1.3K

The Associated Press @AP · Nov 9, 2021

This kicked off a roughly 2 minute struggle, in which the body camera on the officer was shut off for unspecified reasons. According to the Baltimore Police Commissioner, Anderson appeared to grab for the officer's Taser.

107 142 1.9K

The Associated Press @AP · Nov 9, 2021

The officer then pulled out his gun and shot Anderson twice in the chest. The passenger in Anderson's car reportedly called 911, having heard the gunshots, and EMS responded to the scene within 5 minutes of the call being placed.

46 59 1.1K

The Associated Press @AP · Nov 9, 2021

Anderson was rushed to Universal Memorial Hospital, where he was pronounced dead shortly thereafter. The department released four videos that showed the incident from various vantage points, including from the passenger riding with Anderson and the officer's body camera, none of which captured the shooting.

13 21 1K

The Associated Press @AP · Nov 9, 2021

As loved ones processed the news of his loss on Monday, they described his death as "an unforeseen tragedy" in a statement released to the press. According to Anderson's long-time neighbor Angela McDonald, he was compassionate, good with kids, and a talented painter and musician.

87 104 1.8K

The Associated Press @AP · Nov 9, 2021

Friends and family of Derrick Anderson visited the scene of his shooting on Tuesday evening, bringing flowers and balloons to mourn his loss. In a statement released by the Baltimore Police Commissioner, Anderson matched the description of a man seen harassing a woman in a nearby town, armed with "a very large knife,".

18 32 983

References

2017 Police Violence Report. (2017). Mapping Police Violence. https://policeviolencereport.org/

A Stock Studio. (n.d.). Portrait of Afro American man in headphones. A man is listening to music on a city street. [Photograph]. In *Adobe Stock*. Retrieved November 9, 2022, from https://as2.ftcdn.net/v2/jpg/01/82/81/99/1000_F_182819958_B9aHIRBnBkzgUdE0PPO7ma55mmJn8yPA.jpg

Allegheny College - Data USA. (n.d.). Data USA. Retrieved May 4, 2022, from https://datausa.io/profile/university/allegheny-college#:~:text=The%20enrolled%20student%20population%20at%20Allegheny%20College%20is%2068.1%25%20White

Allegheny College Diversity: Racial Demographics & Other Stats. (n.d.). College Factual. Retrieved May 4, 2022, from https://www.collegefactual.com/colleges/allegheny-college/student-life/diversity/

Arza, A., Aguiló, J., Rey, J., Gil, E., Bailón, R., Laguna, P., Camara, C., Lopez-Anton, R., & Lazaro, J. (2018). Measuring acute stress response through physiological signals: towards a quantitative assessment of stress. *Medical & Biological Engineering & Computing*, *2019*(57), 271–287. https://doi.org/10.1007/s11517-018-1879-z

Baik, S. H., Fox, R. S., Mills, S. D., Roesch, S. C., Sadler, G. R., Klonoff, E. A., & Malcarne, V. L. (2019). Reliability and validity of the Perceived Stress Scale-10 in Hispanic Americans with English or Spanish language preference. *Journal of Health Psychology, 24*(5), 628–639. https://doi.org/10.1177/1359105316684938

Bailey, K., West, R., & Mullaney, K. M. (2012). Neural correlates of processing negative and sexually arousing pictures. *PLoS ONE, 7*(9), e45522. https://doi.org/10.1371/journal.pone.0045522

Bauldry, S., & Stainback, K. (2022). Media consumption and psychological distress among older adults in the United States. *PLOS ONE, 17*(12), e0279587. https://doi.org/10.1371/journal.pone.0279587

Belkhiria, C., & Peysakhovich, V. (2020). Electro-Encephalography and Electro-Oculography in Aeronautics: A Review Over the Last Decade (2010–2020). *Frontiers in Neuroergonomics, 1*. https://doi.org/10.3389/fnrgo.2020.606719

Beymer, D., Russell, D., & Orton, P. (2007). Human-Computer Interaction – INTERACT 2007. In C. Baranauskas, P. Palanque, J. Abascal, & S. D. J. Barbosa (Eds.), *Lecture Notes in Computer Science* (pp. 456–460). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-74800-7

Bhadur, S. (2021). *Detection of Facial Emotions while reading online text*. https://erepo.uef.fi/bitstream/handle/123456789/25217/urn_nbn_fi_uef-20210672.pdf?sequence=1

Bhide, A., Durgaprasad, R., Kasala, L., Velam, V., & Hulikal, N. (2016). Electrocardiographic changes during acute mental stress. *International Journal of Medical Science and Public Health, 5*(5), 835. https://doi.org/10.5455/ijmsph.2016.19082015137

Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best Practices for Developing and Validating Scales for Health, Social, and Behavioral Research: A Primer. *Frontiers in Public Health, 6*(149). https://doi.org/10.3389/fpubh.2018.00149

Bor, J., Venkataramani, A. S., Williams, D. R., & Tsai, A. C. (2018). Police killings and their spillover effects on the mental health of black Americans: a population-based, quasi-experimental study. *The Lancet, 392*(10144), 302–310. https://doi.org/10.1016/s0140-6736(18)31130-9

Bulagang, A. F., Weng, N. G., Mountstephens, J., & Teo, J. (2020). A review of recent approaches for emotion classification using electrocardiography and electrodermography signals. *Informatics in Medicine Unlocked*, *20*, 100363. https://doi.org/10.1016/j.imu.2020.100363

Cacioppo, J. T., Tassinary, L. G., Berntson, G. G., & Netlibrary, I. (2007). *Handbook of psychophysiology* (3rd ed.). Cambridge University Press. (Original work published 2007)

Calvo, R. A., & D'Mello, S. (2010). Affect Detection: An Interdisciplinary Review of Models, Methods, and Their Applications. *IEEE Transactions on Affective Computing*, *1*(1), 18–37. https://doi.org/10.1109/t-affc.2010.1

Carter, R. T., Kirkinis, K., & Johnson, V. E. (2019). Relationships between trauma symptoms and race-based traumatic stress. *Traumatology*, *26*(1). https://doi.org/10.1037/trm0000217

Carter, R. T., Mazzula, S., Victoria, R., Vazquez, R., Hall, S., Smith, S., Sant-Barket, S., Forsyth, J., Bazelais, K., & Williams, B. (2013). Initial development of the Race-Based Traumatic Stress Symptom Scale: Assessing the emotional impact of racism. *Psychological Trauma: Theory, Research, Practice, and Policy*, *5*(1), 1–9. https://doi.org/10.1037/a0025911

Center for Disease Control and Prevention. (2019, September 5). *Racial and Ethnic Disparities Continue in Pregnancy-Related Deaths*. Centers for Disease Control and Prevention. https://www.cdc.gov/media/releases/2019/p0905-racial-ethnic-disparities-pregnancy-deaths.html

Chow, A. (2020, December 19). Here's How Shopping Scams On Facebook Are Ripping Off Thousands of Customers, With The Money Flowing Overseas. *Time*. https://time.com/5921820/facebook-shopping-scams-holidays-covid-19/

Cohen, H., Matar, M. A., Kaplan, Z., & Kotler, M. (1999). Power Spectral Analysis of Heart Rate Variability in Psychiatry. *Psychotherapy and Psychosomatics*, *68*(2), 59–66. https://doi.org/10.1159/000012314

Cohen, J. (1988). Statistical power analysis for the behavioral sciences. *Journal of the American Statistical Association*, *73*(363). https://doi.org/10.2307/2286629

Deliso, M. (2022, July 1). Jayland Walker's family demands answers as Akron braces for protests. *ABC News*. https://abcnews.go.com/US/family-demanding-answers-black-man-killed-police-traffic/story?id=86095610

Dhabhar, F. S. (2018). The short-term stress response – Mother nature's mechanism for enhancing protection and performance under conditions of threat, challenge, and opportunity. *Frontiers in Neuroendocrinology*, *49*, 175–192. https://doi.org/10.1016/j.yfrne.2018.03.004

Diangelo, R. (2011). White Fragility. *International Journal of Critical Pedagogy*, *3*(3), 54–70. https://libjournal.uncg.edu/ijcp/article/viewFile/249/116

Diener, E., & Emmons, R. A. (1984). The independence of positive and negative affect. *Journal of Personality and Social Psychology*, *47*(5), 1105–1117. https://doi.org/10.1037/0022-3514.47.5.1105

Dimitriev, D. A., & Saperova, E. V. (2015). Heart rate variability and blood pressure during mental stress. *Rossiiskii Fiziologicheskii Zhurnal Imeni I.M. Sechenova*, *101*(1), 98–107. https://pubmed.ncbi.nlm.nih.gov/25868330/

Egger, M., Ley, M., & Hanke, S. (2019). Emotion Recognition from Physiological Signal Analysis: A Review. *Electronic Notes in Theoretical Computer Science*, *2019*(343), 35–55. https://doi.org/10.1016/j.entcs.2019.04.009

Ekman, P., Levenson, R., & Friesen, W. (1983). Autonomic nervous system activity distinguishes among emotions. *Science*, *221*(4616), 1208–1210. https://doi.org/10.1126/science.6612338

Faria, R., & Almeida, A. (2013). Affect Recognition. *Intelligent Systems, Control and Automation: Science and Engineering*, *61*, 323–332. https://doi.org/10.1007/978-94-007-4722-7_30

Gao, Q., Wang, C., Wang, Z., Song, X., Dong, E., & Song, Y. (2020). EEG based emotion recognition using fusion feature extraction method. *Multimedia Tools and Applications*, *79*(37-38), 27057–27074. https://doi.org/10.1007/s11042-020-09354-y

Gao, Z., Cui, X., Wan, W., & Gu, Z. (2019). Recognition of Emotional States using Multiscale Information Analysis of High Frequency EEG Oscillations. *Entropy*, *21*(6), 609. https://doi.org/10.3390/e21060609

Giakoumis, D., Tzovaras, D., & Hassapis, G. (2013). Subject-dependent biosignal features for increased accuracy in psychological stress detection. *International Journal of Human-Computer Studies*, *71*(4), 425–439. https://doi.org/10.1016/j.ijhcs.2012.10.016

Gustafson, L. W., Gabel, P., Hammer, A., Lauridsen, H. H., Petersen, L. K., Andersen, B., Bor, P., & Larsen, M. B. (2020). Validity and reliability of State-Trait Anxiety Inventory in Danish women aged 45 years and older with abnormal cervical screening results. *BMC Medical Research Methodology*, *20*(1). https://doi.org/10.1186/s12874-020-00982-4

Hasnul, M. A., Aziz, N. A. Ab., Alelyani, S., Mohana, M., & Aziz, A. Abd. (2021). Electrocardiogram-Based Emotion Recognition Systems and Their Applications in Healthcare—A Review. *Sensors*, *21*(15), 5015. https://doi.org/10.3390/s21155015

He, X., Zhang, Y., Chen, M., Zhang, J., Zou, W., & Luo, Y. (2021). Media Exposure to COVID-19 Predicted Acute Stress: A Moderated Mediation Model of Intolerance of Uncertainty and Perceived Social Support. *Frontiers in Psychiatry*, *11*. https://doi.org/10.3389/fpsyt.2020.613368

Hill, E., Tiefenthäler, A., Triebert, C., Jordan, D., Willis, H., & Stein, R. (2020, May 31). How George Floyd Was Killed in Police Custody. *The New York Times*. https://www.nytimes.com/2020/05/31/us/george-floyd-investigation.html

History.com Editors. (2019, August 13). *First enslaved Africans arrive in Jamestown, setting the stage for slavery in North America*. HISTORY; A&E Television Networks. https://www.history.com/this-day-in-history/first-african-slave-ship-arrives-jamestown-colony

Jensen, C., Skene, L., Condon, C., & Anderson, J. (2022, November 7). After “No Shoot Zone” activist killed by Baltimore Police, loved ones point to mental illness, lament police response. *Baltimore Sun*. https://www.baltimoresun.com/news/crime/bs-md-cr-sunday-baltimore-police-shoot-kill-man-20221106-6cyksr3e6bglzi6siswo3bagnu-story.html

Johns Hopkins Medicine. (2019). *The Electromyography (EMG) Laboratory | Johns Hopkins Hospital*. Www.hopkinsmedicine.org. https://www.hopkinsmedicine.org/neurology_neurosurgery/centers_clinics/emg_lab/

Joshi, V. M., & Ghongade, R. B. (2021). EEG based emotion detection using fourth order spectral moment and deep learning. *Biomedical Signal Processing and Control*, *68*, 102755. https://doi.org/10.1016/j.bspc.2021.102755

Julian, L. J. (2011). Measures of anxiety: State-Trait Anxiety Inventory (STAI), Beck Anxiety Inventory (BAI), and Hospital Anxiety and Depression Scale-Anxiety (HADS-A). *Arthritis Care & Research*, *63*(S11), S467–S472. https://doi.org/10.1002/acr.20561

Karthikeyan, P., Murugappan, M., & Yaacob, S. (2011). A Review on Stress Inducement Stimuli for Assessing Human Stress Using Physiological Signals. *International Colloquium on Signal Processing and Its Applications*, *7*, 420–425. https://doi.org/10.1109/CSPA.2011.5759918

Kim, H.-G., Cheon, E.-J., Bai, D.-S., Lee, Y. H., & Koo, B.-H. (2018). Stress and Heart Rate Variability: A Meta-Analysis and Review of the Literature. *Psychiatry Investigation*, *15*(3), 235–245. https://doi.org/10.30773/pi.2017.08.17

Li, K., Rüdiger, H., & Ziemssen, T. (2019). Spectral Analysis of Heart Rate Variability: Time Window Matters. *Frontiers in Neurology*, *10*. https://doi.org/10.3389/fneur.2019.00545

Lim, J. Z., Mountstephens, J., & Teo, J. (2020). Emotion Recognition Using Eye-Tracking: Taxonomy, Review and Current Challenges. *Sensors*, *20*(8), 2384. https://doi.org/10.3390/s20082384

Mark, J. (2022, April 14). Video shows officer fatally shooting Patrick Lyoya in Michigan. *Washington Post*. https://www.washingtonpost.com/nation/2022/04/14/patrick-lyoya-videos-grand-rapids/

Marsh, N., Scheele, D., Postin, D., Onken, M., & Hurlemann, R. (2021). Eye-Tracking reveals a role of Oxytocin in attention allocation towards familiar faces. *Frontiers in Endocrinology*, *12*(629760). https://doi.org/10.3389/fendo.2021.629760

Mayo Clinic Staff. (2018). *EEG (electroencephalogram) - Mayo Clinic*. Mayoclinic.org. https://www.mayoclinic.org/tests-procedures/eeg/about/pac-20393875

Medina, J. (2019). RACIAL VIOLENCE, EMOTIONAL FRICTION, AND EPISTEMIC ACTIVISM. *Angelaki*, *24*(4), 22–37. https://doi.org/10.1080/0969725x.2019.1635821

Nagai, Y., Jones, C. I., & Sen, A. (2019). Galvanic Skin Response (GSR)/Electrodermal/Skin Conductance Biofeedback on Epilepsy: A Systematic Review and Meta-Analysis. *Frontiers in Neurology*, *10*. https://doi.org/10.3389/fneur.2019.00377

Niemic, C. (2004). Studies of Emotion: A Theoretical and Empirical Review of Psychophysiological Studies of Emotion. *University of Rochester Journal of Undergraduate Research*, *1*(1). http://hdl.handle.net/1802/3032

O'Neal, L. (2020, May 28). *George Floyd's mother was not there, but he used her as a sacred invocation*. Andscape. https://andscape.com/features/george-floyds-death-mother-was-not-there-but-he-used-her-as-a-sacred-invocation/

Park, & Lek. (2016). Artificial Neural Networks: Multilayer Perceptron for Ecological Modeling. *Developments in Environmental Modelling*, *28*, 123–140. https://doi.org/10.1016/B978-0-444-63623-2.00007-4

Poell, T., & van Dijck, J. (2015). Social media and activist communication. In C. Atton (Ed.), *The Routledge companion to alternative and community media* (pp. 527–537). London: Routledge. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1071.4203&rep=rep1&type=pdf

Qualtrics. (2018). *How to Determine the Correct Survey Sample Size*. Qualtrics. https://www.qualtrics.com/experience-management/research/determine-sample-size/

Rezal, A. (2021, October 13). *The Racial Makeup of America's Prisons*. U.S. News. https://www.usnews.com/news/best-states/articles/2021-10-13/report-highlights-staggering-racial-disparities-in-us-incarceration-rates#:~:text=According%20to%20the%20report%2C%20Black,at%20261%20per%20100%2C000%20residents.

Rizzo, M. T., & Killen, M. (2020). Children's evaluations of individually and structurally based inequalities: The role of status. *Developmental Psychology*, *56*(12), 2223–2235. https://doi.org/10.1037/dev0001118

Ruediger, H., Seibt, R., Scheuch, K., Krause, M., & Alam, S. (2004). Sympathetic and parasympathetic activation in heart rate variability in male hypertensive patients under mental stress. *Journal of Human Hypertension*, *18*(5), 307–315. https://doi.org/10.1038/sj.jhh.1001671

Santos Fontanez, S. E., & De Jesus, O. (2022). *Neurohypophysis*. PubMed; StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK560733/#:~:text=The%20neurohypophysis%20(pars%20posterior)%20is

Schneiderman, N., Ironson, G., & Siegel, S. D. (2015). Stress and health: Psychological, behavioral, and biological determinants. *Annual Review of Clinical Psychology*, *1*(1), 607–628. https://doi.org/10.1146/annurev.clinpsy.1.102803.144141

Shopify. (n.d.). Picture of Portrait Young Man Smiling - Free Stock Photo [Photograph]. In *Burst*. Retrieved November 9, 2022, from https://burst.shopify.com/photos/portrait-of-a-young-man-smiling?c=smile

Skinner-Dorkenoo, A. L., Sarmal, A., Rogbeer, K., André, C., Patel, B., & Cha, L. (2022). Highlighting COVID-19 racial disparities can reduce support for safety precautions among White U.S. residents. *Social Science & Medicine*, *301*(114951), 1–8. https://doi.org/10.1016/j.socscimed.2022.114951

Spielberg, C., Gorsuch, R., Lushene, R., Vagg, P., & Jacobs, G. (1983). *Manual for the State-Trait Anxiety Inventory*. Consulting Psychologists Press.

Stevens, H. R., Oh, Y. J., & Taylor, L. D. (2021). Desensitization to Fear-Inducing COVID-19 Health News on Twitter: Observational Study. *JMIR Infodemiology*, *1*(1), e26876. https://doi.org/10.2196/26876

Sullivan, G. M., & Feinn, R. (2012). Using effect size—or why the P value is not enough. *Journal of Graduate Medical Education*, *4*(3), 279–282. https://doi.org/10.4300/jgme-d-12-00156.1

Symes, A. (2020). In Memoriam: The Online Policing and Trivialization of Black Lives and Black Deaths. *Student Anthropologist*, *7*(1), 98–102. https://doi.org/10.1002/j.sda2.20200700.0020

Tavakol, M., & Dennick, R. (2011). Making sense of cronbach's alpha. *International Journal of Medical Education*, *2*(2), 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

The Lancet. (2021). Fatal police violence by race and state in the USA, 1980–2019: a network meta-regression. *The Lancet, 398*(10307), 1239–1255. https://doi.org/10.1016/S0140-6736(21)01609-3

Tzevelekakis, K., Stefanidi, Z., & Margetis, G. (2021). Real-Time Stress Level Feedback from Raw Ecg Signals for Personalised, Context-Aware Applications Using Lightweight Convolutional Neural Network Architectures. *Sensors*, *21*(23), 7802. https://doi.org/10.3390/s21237802

Wu, E. X. W., Laeng, B., & Magnussen, S. (2012). Through the eyes of the own-race bias: Eye-tracking and pupillometry during face recognition. *Social Neuroscience*, *7*(2), 202–216. https://doi.org/10.1080/17470919.2011.596946