HHS Public Access
Author manuscript
J Anxiety Disord. Author manuscript; available in PMC 2023 January 01.

Published in final edited form as:
J Anxiety Disord. 2022 January ; 85: 102508. doi:10.1016/j.janxdis.2021.102508.

Ethnic differences in behavioral and physiological indicators of sensitivity to threat

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Abstract

The clinical presentation of anxiety may differ between Hispanics/Latinx (H/L) and non-H/L, although findings on ethnic differences in self-reported anxiety symptoms have been mixed. Fewer studies have focused on ethnic differences in quick and relatively automatic laboratory-assessed indicators of anxiety symptoms, which have the potential to be more objective indicators than self-report. Therefore, the present study examined ethnic differences in two laboratory-assessed indicators of threat sensitivity (an important transdiagnostic mechanism of anxiety): attentional bias to threat and electromyography startle reactivity to threat. White H/L (n = 117) and White non-H/L (n = 168) adults who were matched on demographics and lifetime psychopathology (including anxiety) completed a dot-probe task to assess attentional bias to threat and the No-Predictable-Unpredictable threat (NPU) task to assess startle reactivity to threat. Results indicated that H/L displayed less Slow Orientation$_{RB}$ ($\beta = -0.27$, $p = 0.032$, $R^2_{\beta*} = 0.02$), and increased Slow Disengagement$_{RB}$ ($\beta = 0.31$, $p = 0.016$, $R^2_{\beta*} = 0.02$) compared to non-H/L. H/L exhibited blunted overall startle compared to non-H/L ($\beta = -0.30$, $p = 0.014$, $R^2_{\beta*} = 0.02$), but groups did not differ in startle reactivity to either predictable or unpredictable threat. In summary, H/L and non-H/L may differ in their experience and presentation of anxiety symptoms and such differences may vary across indicators of sensitivity to threat.

Keywords

Hispanic; Latinx; Latino; Anxiety; Attentional Bias; EMG startle

Hispanics/Latinx (H/L) are the largest ethnic minority group in the U.S. and this population is projected to triple by 2050 (Passel & Cohn, 2008; U.S. Bureau of the Census, 2010). Studies have consistently shown that H/L youth report high rates of anxiety symptoms as compared to non-H/L youth (Ginsburg & Silverman, 1996; McLaughlin et al., 2007; Pina & Silverman, 2004; Varela et al., 2004, 2008, 2009; Weems et al., 2002), yet reported rates of

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anxiety symptoms in H/L adults have been mixed (across studies with varying assessments of anxiety, including both state and trait measures; Alegría et al., 2008; Asnaani et al., 2009; Breslau et al., 2006; Chavira et al., 2014; Escobar et al., 1989; Escovar et al., 2018; Grant et al., 2005; Moitra et al., 2014; Smith et al., 2006). There are several possible reasons for these mixed findings.

First, cultural differences in the perceived social acceptability of self-reporting anxiety symptoms may contribute to mixed findings. H/L are more likely to report expectations of stigma related to mental health than non-H/L (Alvidrez & Azocar, 1999; Nadeem et al., 2007; Van Hook, 1999), which could possibly lead to underreporting of anxiety symptoms. Language may also impact the reporting of anxiety as Hirai, Stanley, & Novy (2006) examined the factor structure of self-report anxiety scales and found a two-factor solution consisting of physiological symptoms and worry for Spanish measures while the English measures were unidimensional. Furthermore, H/L may be more likely to experience and/or report different types of anxiety as H/L are more likely than non-H/L to report somatic and physiological symptoms of anxiety (Escovar et al., 2018; Varela et al., 2004). While it is possible that many H/L youth receive early and effective treatment (Pina et al., 2003, 2012) leading to the mixed rates of anxiety symptoms in adulthood, it is also possible that self-reporting anxiety symptoms becomes less socially and culturally acceptable with age (Carter et al., 2011; Zvolensky et al., 2017), which then leads to mixed rates of anxiety and underreporting of anxiety symptoms in H/L adults. This is problematic because underreporting of symptoms in H/L could lead to underdiagnosing of anxiety disorders and negatively impact or impede treatment of anxiety disorders.

Second, H/L adults may differ from non-H/L adults in their experiences of threat, which can contribute to certain anxiety-related phenotypes (Hwang & Goto, 2008; Robinette et al., 2016; Whitfield et al., 2018; Zvolensky et al., 2019). For example, H/L report experiencing more crime in their neighborhoods than non-H/L (Whitfield et al., 2018) and living in such lower income neighborhoods is associated with higher levels of chronic stress (Robinette et al., 2016). H/L also experience perceived racial discrimination (Hwang & Goto, 2008) and such racial discrimination is related to anxiety and anxiety disorders (Zvolensky et al., 2019). Research utilizing more objective assessments of anxiety symptoms is therefore needed to help guide assessment and treatment for this large and increasingly growing population.

As anxiety is heterogeneous (Craske et al., 2011), assessments of anxiety should focus on individual differences in particular trait-like sensitivities rather than broad trait anxiety. The National Institute of Mental Health's (NIMH) Research Domain Criteria (RDoC) similarly strives to classify specific phenotypes of psychopathology (Cuthbert & Insel, 2013; Insel et al., 2010; Kozak & Cuthbert, 2016) by seeking to identify transdiagnostic mechanisms of psychopathology that can be assessed across many levels or units of analysis (i.e., from genes to self-report; (Shankman & Gorka, 2015).

One such transdiagnostic and neurobiological mechanism of anxiety is sensitivity to threat (Grupe & Nitschke, 2013). Sensitivity to threat is defined as individual differences in how people process and respond to threatening stimuli/situations and relates to most anxiety-related psychopathology (Bar-Haim et al., 2007; Carleton, 2016; Correa et al., 2019; McEvoy et al., 2018). Importantly, assessing sensitivity to threat with psychophysiological and behavioral measures in the laboratory is a particularly informative approach towards elucidating ethnic differences in anxiety as they yield quick and relatively automatic responses and therefore reduce the potential influence of impression management and cultural biases in reporting (Nadeem et al., 2007). Such laboratory indicators may help elucidate the mixed findings on ethnic differences in anxiety as they are potentially more objective than self-report indicators (Glover et al., 1999; Ho & Lau, 2011; Kantor et al., 2001; Williams et al., 2008). Investigating ethnic differences in objective indicators of sensitivity to threat is also important for the field of psychophysiological research more broadly as demographic variables, including ethnicity, may be hidden moderators that explain inconsistent findings (Gatzke-Kopp, 2016; Hill et al., 2018; Liu et al., 2017; Nelson et al., 2014).

The present study focused on two widely used objective laboratory indicators of sensitivity to threat: 1) electromyography (EMG) startle response to unpredictable threat and 2) attentional bias (AB) to threat. Accruing evidence suggests that elevated startle eyeblink response is a psychophysiological vulnerability marker for anxiety disorders, both when measured (a) at 'baseline', which is suggested to reflect a general state of heightened vigilance (Gorka et al., 2015; Grillon et al., 2017) and (b) in response to a specific threatening cue (Gorka, Lieberman, Klumpp, et al., 2017; Gorka, Lieberman, Shankman, et al., 2017; Grupe & Nitschke, 2013; Nelson et al., 2013; Shankman et al., 2013). Importantly, responses to particular threatening cues vary depending on whether the threatening cue is unpredictable (U-threat) or predictable (P-threat; Grillon et al., 2006). Indeed, U-threat and P-threat have been shown to have distinct physiological, pharmacological, and neural correlates (Alvarez et al., 2011; Davis, 2006; Grillon et al., 2006, 2009; Grupe & Nitschke, 2013; Moberg & Curtin, 2009) and individuals with anxiety disorders have consistently displayed elevated startle responding to U-threat when compared to healthy controls (Gorka, Lieberman, Klumpp, et al., 2017; Gorka, Lieberman, Shankman, et al., 2017; Grillon et al., 2008; Nelson et al., 2013; Shankman et al., 2013). As prior studies did not assess startle responding across ethnicities or were conducted in primarily White non-H/L samples, it is presently unclear whether there are ethnic differences in startle eyeblink response.

Attentional bias (AB) to threat occurs when a disproportionate amount of attention is given towards, or away from, negative or threatening stimuli as compared to positive or neutral stimuli (Bar-Haim et al., 2007; MacLeod et al., 1986; Mogg & Bradley, 2005). AB has long been viewed as a core feature of anxiety disorders, particularly AB to briefly presented threatening stimuli (Amir et al., 2003, 2012; Bar-Haim et al., 2007). However, prior studies were conducted in primarily White non-H/L samples and, to our knowledge, no study has examined whether H/L and non-H/L exhibit different AB responses. Importantly, traditional measures of AB may not provide a fine-grained assessment of AB that capture intra-individual variability in behavioral performance (Evans & Britton, 2018; McNally, 2019; Schmukle, 2005). Thus, in addition to examining ethnic differences in traditional measures of AB, the present study will also examine ethnic differences in novel, response-based computations of AB that identify more heterogeneous AB processes (Evans et al., 2020); metrics that may have better psychometric properties than traditional metrics of AB to threat (Evans & Britton, 2018; Meissel et al., 2021).

In sum, the aims of the current study are to compare White H/L and White non-H/L individuals on (1) psychophysiological and (2) behavioral indicators of sensitivity to threat in adults. To decrease the likelihood that any ethnic differences might be due to differences in demographic and clinical characteristics including age, gender, education, functioning, or (perhaps most importantly) reported psychopathology, the two groups were matched on these characteristics. It is difficult to make directional hypotheses as it is presently unclear if any ethnic differences in psychophysiological or behavioral indicators of sensitivity to threat should be expected.

Methods

Participants

Participants (N = 285) were drawn from the Chicago, Illinois metropolitan area for a larger NIMH-funded family study on cognitive and affective responding in internalizing psychopathology. A key eligibility criterion for this larger NIMH-funded family study was that each participant had one full sibling who was also interested in participating in the study (see Correa, Liu, & Shankman, 2019; Gorka et al., 2016; Katz, Hee, Hooker, & Shankman, 2017; Weinberg, Liu, Hajcak, & Shankman, 2015 for more information). The subset of participants selected for the current study included 117 White H/L and 168 White non-H/L siblings nested within 163 families that were 18 to 30 years old with a wide range of psychopathologies, as well as healthy controls. An RDoC approach was taken to participant recruitment such that recruitment screening was agnostic to Diagnostic and Statistical Manual of Mental Disorders (DSM) diagnostic categories (beyond the exclusion criteria listed below). However, participants with severe internalizing psychopathology (i.e., anxiety and depression) were oversampled to ensure that the sample was clinically relevant. Thus, the goal was to recruit a sample with normally distributed internalizing symptoms but with a mean more severe than the mean of the general population. Prior to their involvement in the study, participants were screened via telephone using the Depression, Anxiety, and Stress Scale (DASS; Lovibond & Lovibond, 1995), a brief (21- item) measure of broad internalizing psychopathology. Enrollment was then monitored monthly to ensure that the sample had the above-mentioned distribution on DASS internalizing symptoms. Exclusion criteria for the larger study included personal or family history of psychosis or mania, inability to read or write in English, history of serious head trauma, and left-handedness (neurophysiological data was collected for the main aims of the larger study). All participants provided informed consent after reviewing the study procedures. Participant demographic and clinical characteristics are presented in Table 1. White H/L and White non-H/L initially differed (*p*s < .05) on the following demographic and clinical characteristics: age, education, current psychiatric medication use, and lifetime diagnoses of Generalized Anxiety Disorder (note: the two groups did not differ on any other anxiety disorders). Participants were subsequently matched on the aforementioned variables by randomly excluding participants from the larger, White non-H/L group until the groups did not statistically differ from one another. Importantly, by matching the ethnic groups on demographic and clinical characteristics, especially lifetime history of anxiety disorders, any resulting group differences in psychophysiological or behavioral indicators of sensitivity to threat are less likely to be due to differences in self-reported anxiety or differences in demographic characteristics (other than ethnicity).

Measures

Structured clinical interview for diagnostic and statistical manual of mental disorders 5 (SCID).—Psychiatric diagnoses were assessed via the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders-5 (SCID-5; First, Williams, Karg, & Spitzer, 2015). The SCID-5 is a semi-structured clinical interview that assesses diagnoses as defined by the DSM-5. All participants in the current study were assessed for current and lifetime diagnostic criteria of Major Depressive Disorder, Generalized Anxiety Disorder, Post-Traumatic Stress Disorder, Obsessive Compulsive Disorder, Panic Disorder, Agoraphobia, Social Anxiety Disorder, and Specific Phobia (see Shankman et al., 2018 for further details).

Childhood Trauma Questionnaire-Short Form (CTQ-SF).—Given the potential ethnic differences in trauma exposure (Asnaani & Hall-Clark, 2017), the CTQ-SF was used to measure past trauma exposure (Bernstein et al., 1994). The CTQ-SF is a 25-item self-report questionnaire assessing history of childhood abuse and neglect. The CTQ–SF measures five different types of abuse and neglect: emotional abuse, emotional neglect, physical abuse, physical neglect, and sexual abuse. Items are rated based on a 5-point Likert scale ranging from 1 (never true) to 5 (very often true). Scores from each of the five subscales were summed to create a Total score.

Behavioral indicators of sensitivity to threat.—AB to threat was measured using a masked version of the dot-probe task, a commonly used behavioral measure of AB to threat (MacLeod et al., 1986). A masked version of the dot-probe was used in order to more easily isolate early AB to threat. During the dot-probe task, participants were presented with faces displaying either neutral or threatening (i.e., angry) expressions. Each trial began with a 1-s, centered fixation cross, followed by two faces of the same person presented simultaneously and briefly (33-ms) to the left and right of the fixation cross (see Egloff & Hock, 2003; Lavie, 1995; Mathews, Ridgeway, & Williamson, 1996 for details about masked presentation of emotional stimuli). The threatening/neutral faces then disappeared and were replaced with a mask (100-ms) of two images of the same person making a happy face. After the happy face mask, a dot was immediately presented in either the left or right side of the screen, and the reaction time (RT) of participant's detection of the dot's location was recorded (see Cisler, Josh & Koster, Ernst, 2010 for more details). Participants were instructed to press a button corresponding to the side of the screen on which the dot appeared as quickly and accurately as possible.

There were three types of trials for the brief threatening/neutral faces – congruent, incongruent, and neutral. In congruent trials, there is one neutral and one threatening face with the dot replacing the threatening face. In incongruent trials, there is one neutral and one threatening face with the dot replacing the neutral face. In neutral trials, there were two neutral faces with the dot replacing one of the neutral faces. The location of the threatening face was counterbalanced. There were equal numbers of male and female faces and faces with open and closed mouths. Faces were from the NimStim databank (see Tottenham et al., 2009). Due to a computer programming error, the number of trials per condition were unequal (Congruent = 48 trials, Incongruent = 58 trials, Neutral = 38 trials). To ensure an equal number of trials included per conditions, 38 trials of each condition were randomly selected for inclusion in the following analyses, resulting in 114 total trials (79% of trials maintained). Accuracy and reaction times for the dot-probe task are reported in Table 2 for each of the three conditions and by ethnic group.

Participants completed the dot-probe task in both ‘threatening’ and ‘safe’ contexts (the order of safe and threat were counterbalanced). During the threatening context, participants heard random presentations of a woman screaming or garden fork scraping on a chalkboard (stimuli were those used by Lissek et al. (2005) and Neumann & Waters (2006), respectively, who used these sounds as unconditioned stimuli in Pavlovian conditioning). The traditional and response-based measures of AB were comparable under threat vs. safe contexts (all ps > 0.16) as were the reliabilities (Meissel et al., 2021). Thus, to reduce the number of reported results and to increase power, all analyses combined trials from threat and safe contexts.

Behavioral data processing of AB.: As per standard practice, all incorrect trials (i.e., when the subject incorrectly identified the location of the dot) were discarded. To account for outliers in dot-probe data, RT values outside 2.5 standard deviations from each individual’s average RT for each trial type were winsorized (see Price et al., 2015 for a similar approach). Average condition scores were calculated for the three conditions—incongruent, congruent and neutral.

As mentioned above, two types of AB scores were calculated: 1) traditional AB scores and 2) response-based scores. The following three traditional AB scores (Cisler & Koster, 2010; MacLeod et al., 1986) were calculated: (1) Attention $Bias_{Trad}$ (incongruent RT - congruent RT), reflecting attentional vigilance toward (positive scores) and attentional avoidance away (negative scores) from the emotional face; (2) $Disengagement_{Trad}$ (incongruent RT - neutral RT), reflecting disengagement from threat; and (3) $Orientation_{Trad}$ (neutral RT - congruent RT), reflecting orientation to threat. For all three metrics, larger values indicate greater AB.

Response-based measures of AB to threat were also calculated in order to further examine intraindividual variability in AB (Evans et al., 2020; Evans & Britton, 2018). Unlike traditional AB scores, response-based computation methods separately compare the response on each *individual* congruent or incongruent trial against that participant’s mean neutral reference RT. For example, the reaction time to each congruent trial is compared against the mean RT of neutral conditions (i.e. mean neutral - [Trial 1 congruent RT… Trial 2 congruent RT…Trial 3 congruent RT]) and trials in which the difference in RT is positive (i.e., faster for congruent) are averaged into a Fast $Orientation_{RB}$ metric and trials in which the difference in RT is negative (i.e., slower for congruent) are averaged into a Slow $Orientation_{RB}$ metric. Analogous Fast $Disengagement_{RB}$, and Slow $Disengagement_{RB}$ metrics were calculated using individual incongruent trials (Evans & Britton, 2018).

Psychophysiological indicators of sensitivity to threat.—The No-Predictable-Unpredictable threat (NPU) task was used to measure startle eyeblink potentiation to U-threat. The NPU task used in the current study was a variant of that used by Grillon and colleagues (Schmitz & Grillon, 2012) and has been extensively described by our group (Gorka et al., 2015; Shankman et al., 2013). First, participants underwent a workup procedure to determine their idiographic (e.g., "highly annoying, but not painful") shock level between 1–5 mA, followed by a 2-min startle habituation task. Next, participants completed the NPU-threat task, which included no shock (N), predictable shock (P), unpredictable shock (U) conditions indicated via text at the bottom of the screen (i.e., "no shock" [N], "shock at 1" [P], or "shock at any time" [U]). Each condition lasted 145-s, during which a 4-s visual countdown (CD) was presented six times. The interstimulus intervals (ISIs; i.e., time between CDs) ranged from 15 to 21-s during which only the text describing the condition was on the screen. No shocks were delivered during the N condition. A shock was delivered every time the CD reached 1 during the P condition. Shocks were delivered at random during the U condition (both during the CD and ISI). Shocks were administered to participants' left wrist (nondominant hand) for 400 ms. Startle probes were 40-ms, 103 dB bursts of white noise with near-instantaneous rise times presented binaurally through headphones and were administered during both the CD and ISI. Probes and shocks were separated by at least 10-s. Each condition was presented two times in a randomized order (counterbalanced). Participants received 24 total electric shocks (12 in P; 12 in U) and 60 total startle probes (20 in N; 20 in P; 20 in U).

Psychophysiological data collection and processing.—Electromyography data were acquired using BioSemi Active Two (Amsterdam, Netherlands), and stimuli were delivered with PSYLAB (Contact Precision Instruments, London, UK). Startle responses were recorded from two 4mm Ag/AgCl electrodes placed over the left orbicularis oculi muscle. The ground electrode was the frontal pole of an electroencephalography cap (used for the main aims of the larger study). Data were collected using a bandpass filter of DC-500 Hz at a sampling rate of 2000 Hz. Blinks were scored according to published guidelines (Blumenthal et al., 2005). Data processing included applying a 28 Hz high-pass filter, rectifying, then smoothing using a 40 Hz low-pass filter. Blinks were defined as the peak amplitude of electromyography activity within 20–150 ms following startle probe onset relative to baseline (i.e., the 50 ms preceding startle probes). Peaks were identified by software but verified by hand. Blinks were scored as nonresponses (coded as zero) and missing using published guidelines and definitions (Blumenthal et al., 2005). Blink magnitude (i.e., including nonresponses in condition averages) values were used in analyses. Outliers were winsorized at and above 1.5 times the interquartile range.

Statistical Analyses

An a priori power analysis was conducted using an alpha of 0.05. The power analysis indicated that a sample size of 128 (less than the 285 included in the present study) would have more than 80% power to detect medium effects (f=.25), but that a sample size of 787 would be needed to have more than 80% power to detect small effects (f=.10).

As participants were siblings and therefore nested within families, hierarchical linear mixed models were conducted for all models. Age and gender were entered as covariates in all models given their differential effects on psychophysiological variables (Hill et al., 2018). CTQ-SF Total scores were also added as a covariate in all models to account for potential ethnic differences in past trauma exposure (Asnaani & Hall-Clark, 2017). The family-level intercept was entered as a random effect and ethnicity (H/L, non-H/L) was entered as a fixed effect for the hierarchical linear mixed models examining both the traditional and response-based measures of AB. For the traditional AB measures models, the RT value for each AB measure type (Attention $\text{Bias}_{\text{Trad}}$, $\text{Disengagement}_{\text{Trad}}$, $\text{Orientation}_{\text{Trad}}$) served as the dependent variable in its own separate model. For the response-based AB measures models, the response-based calculations of RT for each response-based AB measure type (Fast $\text{Orientation}_{\text{RB}}$, Slow $\text{Orientation}_{\text{RB}}$, Fast $\text{Disengagement}_{\text{RB}}$, Slow $\text{Disengagement}_{\text{RB}}$) served as the dependent variable in their own separate models.

For the EMG startle response model, ethnicity (H/L, non-H/L), condition (no shock, predictable shock, unpredictable shock), and the interaction between ethnicity and condition were entered as fixed effects predictors. To account for additional within-subject variance in this model, both a family-level intercept and a participant nested within family-level intercept were entered as random effects (as conditions were nested within participants and participants were nested within families). Startle magnitude served as the DV. All models were constructed in a top-down fashion and fit by maximum likelihood. All analyses were conducted in version 3.6.1 of R utilizing version 1.1–21 of the lme4 package and version 3.1–0 of the lmerTest package (Bates et al., 2015; Kuznetsova et al., 2017; R Core Team, 2017). The anova function was utilized to return ANOVA (analysis of variance) F test results for the EMG startle response model for ease of interpretation. The anova function, in conjunction with the lmerTest package, was also utilized to compute degrees of freedom via Satterthwaite's method for denominator degrees of freedom. The r2beta function from version 0.1.2 of the r2glmm package was utilized to return $R^2_{\beta*}$, an R^2 statistic that extends to generalized linear mixed models (Jaeger, 2017; Jaeger et al., 2017).

Results

Behavioral Indicators of Sensitivity to Threat

Tables 3 and 4 display results for models investigating behavioral indicators of sensitivity to threat. All analyses investigating behavioral indicators of sensitivity to threat adjusted for age, gender, and childhood trauma exposure.

For the traditional AB measures, H/L and non-H/L did not differ on Attention $\text{Bias}_{\text{Trad}}$ ($\beta = 0.07$, $p = 0.583$, $R^2_{\beta*} = 0.00$), $\text{Disengagement}_{\text{Trad}}$ ($\beta = 0.21$, $p = 0.088$, $R^2_{\beta*} = 0.01$), or $\text{Orientation}_{\text{Trad}}$ ($\beta = -0.15$, $p = 0.220$, $R^2_{\beta*} = 0.01$).

For the response-based AB measures, results revealed that H/L displayed less Slow $\text{Orientation}_{\text{RB}}$ ($\beta = -0.27$, $p = 0.032$, $R^2_{\beta*} = 0.02$) and increased Slow $\text{Disengagement}_{\text{RB}}$ ($\beta = 0.31$, $p = 0.016$, $R^2_{\beta*} = 0.02$) compared to White non-H/L. No differences were found between H/L and non-H/L for Fast $\text{Orientation}_{\text{RB}}$ ($\beta = 0.21$, $p = 0.082$, $R^2_{\beta*} = 0.01$) and Fast $\text{Disengagement}_{\text{RB}}$ ($\beta = -0.16$, $p = 0.189$, $R^2_{\beta*} = 0.01$).

Physiological Indicators

Tables 5–7 display results for models investigating physiological indicators of sensitivity to threat. All analyses investigating physiological indicators of sensitivity to threat adjusted for age, gender, and childhood trauma exposure.

Consistent with prior studies, results indicated a main effect of condition [$F(2,468.87) = 90.18$, $p < 0.001$]. Startle differed among the conditions during CD such that $U_{CD} > P_{CD} > N_{CD}$ ($ps < 0.001$). In addition to demonstrating the NPU-task effect, there was also a main effect of ethnicity [$F(1,235.47) = 6.22$, $p = 0.013$]; H/L displayed reduced startle magnitude compared to non-H/L ($\beta = -0.30$, $p = 0.014$, $R^2_{\beta*} = 0.02$). There were no main effects of age, gender, or childhood trauma exposure and there was no ethnicity X condition interaction.

Discussion

Prior studies on ethnic differences in self-reported anxiety symptoms have been mixed. Thus, the present study examined ethnic differences in more objective behavioral and psychophysiological indicators of sensitivity to threat in White H/L and non-H/L individuals matched on self-reported levels of anxiety symptoms and overall diagnoses of psychopathology. Results for the behavioral measures indicated that White H/L and non-H/L exhibited a pattern of greater AB to threat when assessed by fine-grained response-based measures of AB. Specifically, compared to White non-H/L, White H/L displayed reduced levels of Slow Orientation_{RB} and Slow $\text{Disengagement}_{RB}$, indicative of greater avoidance of threat and poorer regulatory attention, respectively (Cisler & Koster, 2010; Evans et al., 2020). For psychophysiological indicators of sensitivity to threat, White H/L were found to have a blunted overall startle response compared to White non-H/L.

There are several possible reasons why H/L exhibited greater AB to threat. First, while not assessed in the current study, group differences in perceived *neighborhood safety* may have contributed to the behavioral effects. H/L are more likely than non-H/L Whites to perceive their neighborhood as dangerous (Whitfield et al., 2018) and low perceived neighborhood safety is associated with increased risk for anxiety disorders (Alegria et al., 2007; Alegría et al., 2014; Aneshensel & Sucoff, 1996). Prior studies have shown that H/L may also be more likely to experience childhood poly-victimization and trauma-related psychopathology, including Post-Traumatic Stress Disorder (PTSD), than non-H/L (Andrews et al., 2015; Asnaani & Hall-Clark, 2017; López et al., 2017). It is therefore possible that frequent threats to H/L's personal safety led to a processing bias to threats. However, it is important to note that H/L and non-H/L did not differ on levels of childhood trauma exposure in the current study. It is possible that matching participants on rates of lifetime diagnoses, including PTSD, could have also removed any differences in levels of childhood trauma exposure. It is also possible that H/L and non-H/L do not differ on levels of childhood trauma exposure (i.e., the lack of group differences reflects a true null effect). Further research is needed to understand any potential ethnic differences in trauma-related psychopathology and their relation to AB to threat.

Second, the experience of ethnic/racial discrimination could also contribute to H/L's heightened ABs. H/L experience more ethnic/racial discrimination than non-H/L and ethnic/racial discrimination has been shown to increase the risk for, and severity of, psychopathology, including anxiety disorders (Arellano-Morales et al., 2015; Cheng & Mallinckrodt, 2015; Chou et al., 2012; Escovar et al., 2018; Hwang & Goto, 2008; Page-Gould et al., 2014; Zvolensky et al., 2019). AB to threat could therefore be a mechanism through which perceived neighborhood safety, trauma exposure, and/or discrimination lead to increased rates of anxiety symptoms.

Third, it is possible that the race/ethnicity of the faces in the dot-probe task impacted H/L individuals more than non-H/L individuals. The faces in the task were only non-H/L White, Black/African American, and Asian faces and were not matched to the race/ethnicity of the participants. Prior research using the dot-probe task found ABs toward threatening racial *outgroup* faces in individuals both with and without anxiety disorders (Fani et al., 2012; Trawalter et al., 2008). Therefore, it is possible that the faces in the dot-probe task were more arousing and threatening to H/L than non-H/L. Importantly, it is worth noting, that these results are not likely due to reporting biases, as the threatening/neutral faces were masked and only displayed for 33 ms. These results are also likely not due to differences in age, gender, education, functioning, or psychopathology given that the two ethnic groups were matched on these characteristics.

Interestingly, the more fine-grained, response-based, but not traditional, measures of AB revealed ethnic differences in behavioral indicators of sensitivity to threat. The dot-probe's traditional measures of AB have several important limitations including mixed findings regarding convergent validity (Bar-Haim et al., 2007; Kappenman et al., 2014, 2015; Kruijt et al., 2019) and reliability (Evans et al., 2018; Kappenman et al., 2014; Price et al., 2015; Schmukle, 2005; Waechter et al., 2014). Due to these psychometric concerns, the dot-probe task is listed under "Tasks that require further evaluation" within NIMH's RDoC Matrix (National Advisory Mental Health Council Workgroup on Tasks and Measures for Research Domain Criteria (RDoC), 2016). In contrast, several studies have shown the importance of accounting for *intra*-individual variability in AB to threat (Evans & Britton, 2018; Iacoviello et al., 2014; Zvielli et al., 2015). Intra-individual variability in AB may be critical because a person, for example, may be quick to orient to a threat in one trial and slower to do so in the next. Response-based measures of AB are able to assess this kind of intra-individual variability as they compare the individual's response on each trial to the individuals' own average responding. Interestingly, response-based measures that incorporate intra-individual variability in AB to threat have exhibited better reliability and validity compared to traditional measures (Evans & Britton, 2018; Meissel et al., 2021), are associated with separate neural circuitry (Evans et al., 2020) and may, therefore, be more sensitive to detecting between group differences. Indeed, in the present paper, H/L individuals exhibited both slower orientation to threat (which may be indicative of a tendency to direct attention away from threat in an attempt to avoid the negative affect elicited by threat) and slow disengagement from threat (which may reflect more elaborative processing of threats that stem from poor regulatory attention; Cisler & Koster, 2010; Evans et al., 2020). More generally, findings highlight the heterogeneity in AB processes and that there may be select ethnic differences in some, but not all, of these processes.

To our knowledge, the present study is the first to show that H/L individuals exhibit greater AB to threat than non-H/L individuals. These findings do, however, support the results from Amir, Taylor, & Donohue's (2011) investigation into treatment predictors for an attention bias modification treatment for social phobia, a computerized intervention designed to improve AB to threat. In this study, independent of baseline anxiety symptoms, non-White patients had a greater reduction in anxiety symptoms than white patients (analyses were not adequately powered to examine specific racial and ethnic groups such as H/L). It is possible that non-Whites, including H/L, may have had greater AB to threat at baseline and, thus, greater 'room for change' as a result of treatment. This would suggest that AB to threat may best be treated using a *compensation approach* (where treatment focuses on pre-existing deficits), rather than a *capitalization approach* (where treatment focuses on pre-existing strengths; Burkhouse et al., 2018; Cheavens, Strunk, Lazarus, & Goldstein, 2012; Wingate, Van Orden, Joiner, Williams, & Rudd, 2005). This is quite speculative and future studies that randomize people to treatment conditions based on their baseline AB to threat are needed to fully test this hypothesis (Simon & Perlis, 2010).

In contrast to results for behavioral indicators of sensitivity to threat, White H/L demonstrated a *diminished overall* startle response compared to non-H/L but did not differ in startle responding *across* threat conditions. The lack of ethnic differences in startle responding *across* threat conditions replicates findings from Nelson et al. (2014) and suggests that responses to unpredictable threat play similar roles in anxiety symptoms across ethnic groups. While H/L individuals did not exhibit differential reactivity to threat from non-H/L individuals, H/L did exhibit a blunted general pattern of defensive responding. This diminished startle response may reflect a greater tendency to regulate (or perhaps over-regulate) emotion. Similar patterns of over-regulation have been found across various psychopathologies (Brockmeyer et al., 2019; Gorka, Lieberman, Shankman, et al., 2017; McTeague et al., 2010; Shankman et al., 2013). However, H/L and non-H/L were matched on current and lifetime anxiety disorders, posttraumatic stress disorder, and major depressive disorder, thus the finding of blunted physiological responding is likely not due to internalizing psychopathology. On the other hand, chronic stress has been shown to lead to blunted physiological responding (Miller et al., 2007) and H/L individuals have been shown to exhibit more chronic levels of stress, in part due to greater concerns about ethnic/racial discrimination (Flores et al., 2008; Robinette et al., 2016). Indeed, a recent review by Lockwood et al. (2018) found that perceived discrimination was associated with blunted cortisol responding, a physiological indicator of over-active stress responding. Future studies are needed to examine how ethnic discrimination affects startle responding in H/L individuals.

Taken together with the behavioral results, ethnic differences in indicators of sensitivity to threat may vary depending upon the unit of analysis chosen as the dot-probe task elicited a cognitive indicator (and an indicator of an early cognitive process given the masked faces version of the dot-probe) while the startle task measured a physiological one. Relatedly, the behavioral and psychophysiological indicators employed in the present investigation differ in their neurobiological bases; startle relates to activation of limbic and ventral neural regions (e.g., extended amygdala; dorsal ACC) while AB relates to more cortical regions (e.g., dorsolateral prefrontal cortex; Boecker & Pauli, 2019; Grupe & Nitschke, 2013;

Heeren, De Raedt, Koster, & Philippot, 2013). Ethnic differences in anxiety symptoms may, therefore, vary across the neurobiological systems involved in anxiety.

However, the different results may also reflect that the two tasks used different types of threat – negative faces (dot-probe) vs. shock (startle task).[1] The negative faces utilized in the dot-probe task are social threats and may perhaps be more relevant to H/L's experiences than the physical threat of an electric shock. H/L experience more discrimination than White non-H/L individuals and all the faces were racial/ethnic out-group members (for H/L). The visual stimuli of negative *outgroup* faces in the dot-probe task and the proprioceptive stimuli of shock in the startle task are also mediated by different neural circuitry (Ahmad & Abdul Aziz, 2014; Amin et al., 2004; Hart et al., 2000; Linnman et al., 2013). In sum, ethnic differences in sensitivity to threat may vary by unit of analysis and by type of threatening stimuli.

Prior studies on ethnic differences in anxiety psychopathology have almost exclusively focused on the self-report measures of anxiety symptoms and reported mixed results. Many studies have found few to no differences in self-reported indicators of anxiety symptoms between H/L and non-H/L adults (Breslau et al., 2006; Chavira et al., 2014; Escovar et al., 2018; McLean et al., 2011; Norton, 2005), while H/L *youth* report increased levels of anxiety symptoms (Ginsburg & Silverman, 1996; McLaughlin et al., 2007; Pina & Silverman, 2004; Varela et al., 2004, 2007, 2008; Weems et al., 2002). These prior studies on ethnic differences in youth have sampled variable ages of H/L and White non-H/L youth (ranging from six to seventeen years old), some only included English speaking youth while others included both English and Spanish speakers. These studies have also utilized a wide range of self-reported anxiety including broad internalizing symptoms, somatic symptoms, physiological worry, and anxiety sensitivity. Similarly, studies yielding mixed findings in ethnic differences in adults have also utilized a wide range of operational definitions of anxiety including prevalence of all anxiety disorders, prevalence of panic disorder specifically, self-reported panic symptoms, self-reported anxiety sensitivity, and self-reported somatic symptoms. In addition to variability in demographics and assessment, several other factors may have also contributed to these mixed findings. Factors such as time living in the U.S., social acceptability of self-reporting, acculturation, language, nativity, and socioeconomic status have all been shown to both impact psychopathology and differ between H/L and non-H/L (Alegría et al., 2008, 2014; Alvidrez & Azocar, 1999; Arellano-Morales et al., 2015; Nadeem et al., 2007; Ortega et al., 2000; Potochnick & Perreira, 2010; Van Hook, 1999; Varela et al., 2004). These variables were, unfortunately, not available in the present dataset and thus represent critical areas of future research to better understand ethnic differences in anxiety symptoms and laboratory indicators of threat responding.

Notably, the reported effect sizes for the behavioral and psychophysiological ethnic differences in sensitivity to threat are all small. These small effect sizes indicate that any differences between White H/L and non-H/L in sensitivity to threat are likely small differences and perhaps due to our relatively large sample size. Moreover, as studies of

[1]Of note, while startle responding was measured in response to the auditory startle probes in the NPU-task and not in response to the electric shocks themselves, the shocks served as the primary threatening stimuli in the startle task.

ethnic differences in psychopathology have quite varied sample sizes, variability in power has also likely contributed to the mixed findings in reported rates of anxiety symptoms in H/L adults.

The present study had several strengths as well as limitations that suggest future directions for investigations into ethnic differences in anxiety disorders. This was one of the first studies, to our knowledge, to examine ethnic differences in anxiety symptoms across multiple indicators of sensitivity to threat. Furthermore, both ethnic groups were matched across many demographic and psychiatric characteristics (most notably in rates of DSM-defined anxiety disorders), thus, results are likely not due to group differences in these characteristics. However, the present study did not match participants on somatic symptoms of anxiety (which were not assessed in the dataset) and prior studies have highlighted ethnic differences in somatic anxiety (Escobar et al., 1989; Escovar et al., 2018). The present study also did not assess other important cultural and environmental factors that relate to psychopathology and differ between H/L and non-H/L such as acculturation, language, nativity, neighborhood safety, discrimination, stressors, and socioeconomic status.

In summary, the present study was among the first to examine ethnic differences in multiple objective phenotypes of anxiety and focused on differences in sensitivity to threat. Results revealed that White H/L displayed increased AB towards threat compared to White non-H/L on reaction time measures, but displayed reduced defensive system responding compared to White non-H/L on physiological measures. Ethnic differences in anxiety symptoms may, therefore, vary based on the method of assessment and neurobiological systems involved in the specific anxiety response being measured. These results further emphasize the need to, at a minimum, assess demographic variables such as ethnicity and include these variables as covariates or moderators in behavioral and psychophysiological research. More generally, as H/L are a large and growing subset of the U.S., and H/L are less likely to seek mental health services than other demographics (Chavira et al., 2014), further studies are needed to understand ethnic differences in biological, cultural, and treatment factors for anxiety disorders.

Acknowledgments

We would like to thank Travis C. Evans and Jennifer C. Britton for their help with data preparation. This work was supported by grants from the National Institute of Mental Health (F31 MH121003 [PI: Correa]; R01MH098093, R01 MH119771 and R21DA045285 [PI: Shankman]).

This work was supported by the National Institutes of Health (R01MH098093, R01 MH119771, and R21 DA045285 [PI: Shankman] and F31 MH121003 [PI: Correa]).

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Highlights

- Examined ethnic differences in behavioral and physiological indicators of anxiety
- Hispanics/Latinx (H/L) exhibited blunted overall startle compared to non-H/L
- Groups did not differ in startle reactivity to predictable or unpredictable threat
- H/L exhibited greater attentional abnormalities to threat than non-H/L
- Ethnic differences in anxiety may vary across indicators of anxiety

Table 1.

Participant Demographic and Clinical Characteristics

	Hispanic/Latinx (n = 117)	Non-Hispanic/Latinx (n = 168)	*p* value
Age (mean [SD])	21.77 (3.11)	22.05 (2.72)	0.414
Gender (% Female)	72 (61.5)	109 (64.9)	0.652
Education (%)			0.097
High school graduate or less	11 (9.4)	9 (5.4)	
Some college or 2-year degree	77 (66.4)	102 (60.8)	
4-year college degree	19 (16.4)	34 (20.2)	
Some graduate school	7 (6.0)	16 (9.5)	
Graduate degree	2 (1.7)	7 (4.2)	
Global Assessment of Functioning Symptom Severity (mean [SD])	73.58 (13.37)	72.61 (13.94)	0.558
Global Assessment of Functioning Impairment (mean [SD])	76.00 (11.64)	75.08 (13.36)	0.549
Childhood Trauma Questionnaire-Short Form Total Score (mean [SD])	36.11 (11.06)	35.39 (11.3)	0.596
On psychiatric medication (%)	6 (5.1)	18 (10.7)	0.146
Current diagnosis (n, %)			
Major Depressive Disorder	1 (0.9)	6 (3.6)	0.285
Generalized Anxiety Disorder	6 (5.1)	8 (4.8)	1.000
Post-traumatic Stress Disorder	0 (0.0)	3 (1.8)	0.388
Obsessive-Compulsive Disorder	5 (4.3)	5 (3.0)	0.796
Panic Disorder	3 (2.6)	5 (3.0)	1.000
Agoraphobia	0 (0.0)	1 (0.6)	1.000
Social Anxiety Disorder	14 (12.0)	16 (9.5)	0.642
Specific Phobia	17 (14.5)	21 (12.5)	0.750
Lifetime diagnosis (n, %)			
Major Depressive Disorder	34 (29.3)	58 (34.5)	0.427
Generalized Anxiety Disorder	8 (6.8)	20 (11.9)	0.226
Post-traumatic Stress Disorder	4 (3.4)	9 (5.4)	0.629
Obsessive-Compulsive Disorder	7 (6.0)	15 (8.9)	0.490
Panic Disorder	6 (5.1)	14 (8.3)	0.420
Agoraphobia	0 (0.0)	2 (1.2)	0.643
Social Anxiety Disorder	22 (18.8)	34 (20.2)	0.882
Specific Phobia	26 (22.2)	31 (18.5)	0.527

Table 2.

Dot-Probe Task Accuracy and Reaction Times

Metric	Condition	Hispanic/Latinx (n = 117)	Non-Hispanic/Latinx (n = 168)
Accuracy	Congruent	99%	99%
	Incongruent	99%	99%
	Neutral	99%	99%
Reaction Time	Congruent (mean [SD])	402.95 (61.51)	385.72 (52.19)
	Incongruent (mean [SD])	407.64 (63.06)	389.26 (51.75)
	Neutral (mean [SD])	406.59 (61.97)	391.34 (52.65)

Table 3

Linear Mixed Models for Traditional Attention Bias Measures

Dependent Variable	Predictors	Estimate	Standard Error	*df*	*p* Value	$R^2_{\beta*}$
Attention Bias	Model	-	-	-	-	0.02
	Intercept	−0.23	0.50	251.29	0.651	-
	Gender	0.23	0.13	262.95	0.074	0.01
	Age	0.00	0.02	258.44	0.897	0.00
	CTQ-SF Total	0.00	0.01	255.41	0.560	0.00
	Ethnicity	0.07	0.13	154.92	0.583	0.00
Disengagement	Model	-	-	-	-	0.02
	Intercept	0.07	0.50	271.00	0.887	-
	Gender	0.18	0.13	271.00	0.142	0.01
	Age	−0.01	0.02	271.00	0.621	0.00
	CTQ-SF Total	0.00	0.01	271.00	0.835	0.00
	Ethnicity	0.21	0.12	271.00	0.088	0.01
Orientation	Model	-	-	-	-	0.01
	Intercept	−0.32	0.50	271.00	0.525	-
	Gender	0.04	0.13	271.00	0.757	0.00
	Age	0.01	0.02	271.00	0.683	0.00
	CTQ-SF Total	0.00	0.01	271.00	0.417	0.00
	Ethnicity	−0.15	0.12	271.00	0.220	0.01

Note: CTQ = Childhood Trauma Questionnaire

Table 4

Linear Mixed Models for Response-Based Attention Bias Measures

Dependent Variable	Predictors	Estimate	Standard Error	*df*	*p* Value	$R^2_{\beta*}$
Fast Orientation	Model	-	-	-	-	0.03
	Intercept	0.10	0.49	271.00	0.846	-
	Gender	0.14	0.12	271.00	0.256	0.01
	Age	−0.03	0.02	271.00	0.233	0.01
	CTQ-SF Total	0.01	0.01	271.00	0.155	0.01
	Ethnicity	0.21	0.12	275.00	0.082	0.01
Slow Orientation	Model	-	-	-	-	0.03
	Intercept	−0.67	0.50	248.81	0.176	-
	Gender	−0.10	0.13	261.12	0.415	0.00
	Age	0.04	0.02	256.23	0.063	0.01
	CTQ-SF Total	0.00	0.01	253.14	0.964	0.00
	Ethnicity	−0.27	0.12	157.69	0.032	0.02
Fast Disengagement	Model	-	-	-	-	0.02
	Intercept	0.55	0.50	251.06	0.267	-
	Gender	−0.18	0.13	262.30	0.154	0.01
	Age	−0.01	0.02	257.87	0.787	0.00
	CTQ-SF Total	−0.01	0.01	255.03	0.206	0.01
	Ethnicity	−0.16	0.12	163.14	0.189	0.01
Slow Disengagement	Model	-	-	-	-	0.03
	Intercept	−0.18	0.50	258.63	0.718	-
	Gender	0.18	0.13	267.06	0.164	0.01
	Age	0.00	0.02	264.01	0.820	0.00
	CTQ-SF Total	0.00	0.01	261.68	0.823	0.00
	Ethnicity	0.31	0.13	161.57	0.016	0.02

Note: CTQ-SF = Childhood Trauma Questionnaire-Short Form

Table 5

ANOVA for Physiological Indicators of Sensitivity to Threat

Dependent Variable	Independent Variable	Numerator Degrees of Freedom	Denominator Degrees of Freedom	*F* Value	*p* Value
EMG Startle Magnitude	Gender	1.00	235.52	0.10	0.753
	Age	1.00	235.61	0.00	0.951
	CTQ-SF Total	1.00	235.61	0.02	0.882
	Ethnicity	1.00	235.47	6.22	0.013
	NPU Condition	2.00	468.87	90.18	<0.001
	Ethnicity X NPU Condition	2.00	468.87	2.27	0.104

Note: CTQ = Childhood Trauma Questionnaire-Short Form

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Table 6

Linear Mixed Model Following up the Main Effect of Ethnicity on EMG Startle Magnitude

Predictors	Estimate	Standard Error	*df*	*p* Value	$R^2_{\beta*}$
Model	-	-	-	-	0.04
Intercept	0.10	0.11	235.40	0.335	-
Gender	0.04	0.12	235.61	0.760	0.00
Age	0.00	0.06	235.72	0.938	0.01
CTQ-SF Total	−0.01	0.06	235.72	0.891	0.01
Ethnicity	−0.30	0.12	235.54	0.014	0.02

Note: CTQ = Childhood Trauma Questionnaire-Short Form

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Table 7

Linear Mixed Model Following up the Main Effect of NPU Condition on EMG Startle Magnitude

Comparison Condition	Predictors	Estimate	Standard Error	*df*	*p* Value	$R^2_{\beta*}$
-	Model	-	-	-	-	0.06
No Shock	Intercept	−0.27	0.10	263.41	0.007	-
	Gender	0.06	0.12	235.46	0.623	0.00
	Age	0.01	0.06	235.56	0.879	0.01
	CTQ-SF Total	−0.01	0.06	235.53	0.876	0.01
	Predictable Shock	0.19	0.04	469.03	< 0.001	0.01
	Unpredictable Shock	0.52	0.04	469.03	< 0.001	0.04
Predictable Shock	Intercept	−0.08	0.10	263.34	0.442	-
	Gender	0.06	0.12	235.46	0.623	0.00
	Age	0.01	0.06	235.56	0.879	0.01
	CTQ-SF Total	−0.01	0.06	235.53	0.876	0.01
	No Shock	−0.19	0.04	469.03	< 0.001	0.01
	Unpredictable Shock	0.33	0.04	468.58	< 0.001	0.02
Unpredictable Shock	Intercept	0.25	0.10	263.34	0.010	-
	Gender	0.06	0.12	235.46	0.623	0.00
	Age	0.01	0.06	235.56	0.879	0.01
	CTQ-SF Total	−0.01	0.06	235.53	0.876	0.01
	No Shock	−0.52	0.04	469.03	< 0.001	0.04
	Predictable Shock	−0.33	0.04	468.58	< 0.001	0.02

Note: CTQ = Childhood Trauma Questionnaire-Short Form