Journal Pre-proof

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PII: S0301-0511(21)00045-4

DOI: https://doi.org/10.1016/j.biopsycho.2021.108054

Reference: BIOPSY 108054

To appear in: *Biological Psychology*

Received Date: 15 June 2020

Revised Date: 24 December 2020

Accepted Date: 15 February 2021

Please cite this article as: McLamore Q, Leidner B, Park J, Hirschberger G, Li M, Reinhard D, Beals K, Strong Hearts, Open Minds: Cardiovascular Challenge Predicts Non-Defensive Responses to Ingroup-Perpetrated Violence, *Biological Psychology* (2021), doi: https://doi.org/10.1016/j.biopsycho.2021.108054

Running head: CHALLENGE RESPONSES AND INTERGROUP VIOLENCE

Word count: 6,921

Strong Hearts, Open Minds: Cardiovascular Challenge Predicts Non-Defensive Responses to Ingroup-Perpetrated Violence

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Highlights

- We link cardiovascular states of challenge/threat to reactions to ingroup-perpetrated violence.
- Participants read about either ingroup- or outgroup-perpetrated violence.
- CV measures were collected during introductions to a confederate from the victim group.

- Challenge was associated with non-defensive responses to ingroup-perpetrated violence.
- Challenge/threat states may help explain divergent reactions to ingroup-perpetrated violence.

Abstract

Reminders of ingroup-perpetrated violence represent a psychological stressor that some people respond to defensively (e.g., justifying the violence), while others react non-defensively (e.g., accepting collective responsibility). To explain these divergent responses, we applied the biopsychosocial model of challenge and threat to the context of intergroup conflict. Participants (*N*=130) read about either an ingroup (American) or outgroup (Australian) soldier torturing an Iranian captive. We recorded cardiovascular responses while participants video-recorded introductions to an Iranian confederate who they believed they would meet. In the ingroup (but not the outgroup) condition, cardiovascular responses of challenge (relative to threat) were associated with less psychological defensiveness of ingroup-perpetrated violence and greater support for diplomacy towards its victims. Self-reported challenge/threat appraisals demonstrated no such relationships. These findings suggest that motivational states of challenge and threat can differentiate defensive and non-defensive responses, and that these motivational states may be better captured with physiological rather than self-report measures.

Keywords: cardiovascular reactivity, challenge and threat, intergroup conflict, ingroup defensiveness, social identity, stress

Within the study of intergroup violence, people are often found to be psychologically defensive of violence that their own group has inflicted upon another group. Because people are motivated to view groups they identify with positively (Tajfel & Turner, 1979), it is thought that violence perpetrated by one's own (in-)group upon other groups frustrates this motivation by morally indicting the ingroup (Branscombe, Ellemers, & Spears, 1999; Hirschberger, Kende, & Weinstein, 2016). Thus, ingroup-perpetrated violence represents a salient psychological stressor (for a review, see Leidner, Li, & Kardos, 2015). Rationalizing, justifying, or denying the violence perpetrated (Bandura, 1999; Castano & Giner-Sorolla, 2006) and rejecting collective guilt (Roccas, Klar, & Liviatan, 2006) represent psychological defense mechanisms of coping with such stressors.

However, people can also respond non-defensively to ingroup-perpetrated violence, accepting collective guilt (Roccas et al., 2006), and even supporting efforts to pursue justice for the victims (Iyer, Schmader, & Lickel, 2007). Yet, what shapes these individual differences in responses to ingroup-perpetrated violence? Following conceptualizations of ingroup-perpetrated violence as social identity stress for members of the perpetrator group (Leidner et al., 2015), we theorized that individual differences in physiological stress responses provide fertile ground for innovative investigations into differences in psychological defensiveness in response to ingroup-perpetrated violence. To examine physiological stress responses, we utilized the *biopsychosocial model of challenge and threat* (Blascovich & Tomaka, 1996; Blascovich & Mendes, 2000), which posits that autonomic physiological stress responses can be differentiated into distinct patterns that index particular motivational states based on cognitive appraisals of demands of a stressor in relation to resources to deal with these demands. If resources are deemed insufficient to cope with the demands of the stressor, an avoidance-oriented state of *threat* is experienced. In

contrast, if resources are deemed sufficient for coping with the demands of the stressor, an approach-oriented state of *challenge* is experienced (Blascovich & Mendes, 2000). In the present research, we applied this model to examine whether motivational states of challenge (vs. threat) account for individual differences in non-defensive (vs. defensive) reactions to ingroup-perpetrator violence.

Defensiveness and Non-Defensiveness

Defensive and non-defensive reactions to ingroup-perpetrated violence represent different ways to cope with stress. Defensive responses reinforce the ingroup's morality (for reviews, see Hirschberger et al., 2016; Leidner et al., 2015) through moral disengagement (Bandura, 1999). Moral disengagement dehumanizes victim group members (Bandura, 1999), while also justifying or rationalizing violence against them (Castano & Giner-Sorolla, 2006; Leidner & Castano, 2012; Leidner, Castano, Zaiser, & Giner-Sorolla, 2010). While these defensive coping strategies can reduce aversive emotional experiences (e.g., guilt, shame; Aquino, Reed, Thau, & Freeman, 2007) and thereby buffer self-reported subjective well-being at least in the short term (Leidner et al., 2015), they nevertheless reinforce violent conflict between groups (Li, Leidner, Petrovic, Orazani, & Rad, 2018; Shnabel & Nadler, 2008).

Conversely, *non*-defensive reactions represent acknowledgement of the ingroup's moral indictment and acceptance of a damaged moral image (Bandura, 1999; Leidner et al., 2015). Non-defensive coping strategies encompass an absence of defensive coping strategies alongside the presence of more proactive coping strategies, such as ingroup criticism and dissent (for a review, see Packer & Miners, 2014), as well as collective action opposing morally questionable ingroup behavior (Leidner et al., 2015). Although non-defensiveness may elicit negative emotional reactions such as guilt and shame and therefore decrease subjective well-being in the

short term (Aquino et al., 2007; Lickel, Steel, & Schmader, 2011; Roccas et al., 2006), these emotions can motivate actions to address injustice in the long term (Doosje, Branscombe, Spears, & Manstead, 1998; Leach, Iyer, & Pedersen, 2006).

Threat and Challenge, and (Non-)Defensiveness

Prior evidence suggests that the motivational state of challenge (rather than threat) is generally linked to approach-oriented, engaged, and successful reactions to stressors across multiple domains beyond intergroup conflict and violence, including athletics (Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004), academics (Seery, Weisbuch, Hetenyi, & Blascovich, 2010), interpersonal interactions (Mendes, Blascovich, Hunter, Lickel, & Jost, 2007; Mendes, Major, McCoy, & Blascovich, 2008), and interracial interactions (Mendes, Blascovich, Lickel, & Hunter, 2002; Mendes et al., 2008). Yet, in the context of intergroup violence, links between threat and challenge on the one side, and defensiveness and non-defensiveness on the other, have been assumed theoretically but not tested empirically. This lack of empirical knowledge is particularly jarring because in modern times of globalization and around-the-clock news and media coverage, reminders of ingroup-perpetrated violence can represent a chronic stressor in people's lives.

We hypothesized that people's reactions to ingroup-perpetrated violence depend on whether the social identity stress induced by their group's perpetrator status elicits a motivational state of challenge or threat. Challenge states represent a motivational tendency to approach a stressor, whereas threat represents a motivational tendency to avoid that same stressor (for a review, see Seery, 2013). Within the context of ingroup-perpetrated violence, the *stressor* encompasses the harm the ingroup has perpetrated upon outgroup members and the moral transgression the group has committed by doing so. By this logic, defensive responses to

ingroup-perpetrated violence such as moral disengagement (e.g., moral indictment of the ingroup; Bandura, 1999) represent avoidance of the stressor, whereas non-defensive responses (e.g., collective action protesting ingroup transgressions; Iyer et al. 2007) represent approach toward the stressor. Therefore, we hypothesized that participants would respond *non-defensively* to the extent that they experienced a motivational state of *challenge* (rather than threat).

The Biopsychosocial Model of Challenge and Threat

A key component of the biopsychosocial model of challenge and threat is that motivational states of challenge and threat are manifested on the physiological level and distinguished by cardiovascular patterns (Blascovich & Tomaka, 1996; Blascovich & Mendes, 2000). The four key indicators of these states are heart rate (HR), ventricle contractility (VC; a measure of the left ventricle's contractile force), cardiac output (CO; amount of blood pumped by the heart per minute), and total peripheral resistance (TPR; a measure of vasoconstriction in the arterial system) (Lamarche, Seery, Kondrak, Saltsman, & Streamer, 2020; Seery, 2011; Seery, 2013). Both challenge and threat states involve activation of the sympathetic nervous system (SNS) via activation of the sympathetic-adrenomedullary (SAM) and pituitary-adrenocortical (HPA) axes, indexed by increases in HR and VC compared to baseline (Seery, 2013; Mendes & Park, 2014). Yet, challenge states are characterized by heightened cardiac efficiency (CO increases while TPR decreases) and thus more oxygenated blood in the body, whereas threat states are characterized by decreased cardiac efficiency (CO decreases while TPR increases) and thus less oxygenated blood in the body (Blascovich & Mendes, 2000; Seery, Weisbuch, & Blascovich, 2009).

Challenge states are typically conceptualized as not merely the absence of threat, but the presence of a distinct approach orientation toward a stressor characterized by physiological

resilience and fortitude (Dienstbier, 1989; Seery, 2011; Seery, 2013). While there are circumstances in which decreased cardiac efficiency (i.e., the cardiovascular pattern associated with threat) is an adaptive response to acute stress (e.g., when the body must brace for damaging impacts; see Dickerson & Kemeny, 2004; Yeager, Lee, & Jamieson, 2016), challenge is generally associated with more positive task performance outcomes than threat (Blascovich, 2008; Mendes & Park, 2014; Akinola & Mendes, 2014; Jamieson, Hangen, Lee, & Yeager, 2018).

The physiological resilience associated with the distinctive presence of a motivational state of challenge (rather than merely an absence of a motivational state of threat) also helps answer the pressing question of why some people at times respond non-defensively to ingroup-perpetrated violence: If people can approach this stressor from a resilient position, they may have the capacity to cope with it without being defensive. This will also correct a potential mischaracterization by past research of non-defensiveness as being costly (for a review, see Leidner et al., 2015). Instead, whether or not non-defensiveness is psychologically costly may be contingent upon whether the psychological stressor is processed through threat or challenge.

Research Overview

By applying the biopsychosocial model of challenge and threat to the context of intergroup conflict, we tested whether cardiovascular patterns of challenge vs. threat distinguish self-reported defensive and non-defensive reactions to ingroup-perpetuated violence. American participants (*N*=130) read a scenario in which either an ingroup (American) or an outgroup (Australian) soldier had tortured an Iranian captive, while under the impression that they would afterwards discuss the scenario with an Iranian student (a confederate who is a member of the victim group). We hypothesized that more challenge (less threat) should be associated with less

defensive reactions to ingroup-perpetrated violence (and vice-versa) in the ingroup-perpetrator condition. Within the context of our study design, challenge represents a physiologically-resilient approach pattern toward engaging with the confederate, a member of the outgroup that the participant's ingroup harmed, whereas threat represents a less efficient, less resilient avoidant pattern seeking distance from the confederate and the stressor that the confederate represents. In this context, then, psychological defensiveness maps onto threat in that moral disengagement (e.g., justifying the violence perpetrated, perceiving Iran as an enemy) is an avoidant reaction to the stressor elicited by the anticipated interaction with the confederate, whereas non-defensiveness (e.g., support for diplomatic conflict resolution policies) maps onto challenge, reflecting one's motivational tendency to approach that same stressor instead.

Importantly, we hypothesized that these relationships would be observed only in the ingroup-perpetrator condition, wherein social identity-based stress should be activated. In contrast, we did not expect any such relationship in the outgroup-perpetrator condition, as exposure to outgroup-perpetuated violence would not elicit social identity-based stress in anticipation of the interaction with the member of the victim group. Thus, we hypothesized that condition (ingroup- vs. outgroup-perpetrator) would moderate the relationship between challenge-vs.-threat and (non-)defensiveness toward intergroup violence.

We tested our hypotheses by differentiating challenge and threat states based on participants' cardiovascular responses as these motivational states are likely driven by appraisal mechanisms that may occur outside conscious awareness (Blascovich & Mendes, 2000; for a review, see Seery, 2013). To demonstrate this point further, we also included abridged self-reported measures of cognitive appraisals (demands vs. resources) to distinguish cardiovascular

challenge vs. threat responses from the presence or absence of self-reported challenge vs. threat and also test how cognizant participants may be of these appraisal processes.

Method

Participants

We recruited 130 undergraduate students (26 men, 102 women, 2 unreported gender; age: *M*=20.01, *SD*=1.61) from a large university in the Northeastern United States. Because this study was the first, to our knowledge, to link cardiovascular challenge and threat to psychological defensiveness of a national group, we did not have prior evidence regarding the exact effect size we might expect for this novel study. Thus, we conducted an *a priori* power analysis using G*Power 3.1.9.2. (Faul, Erdfelder, Buchner, & Lang, 2009), assuming a medium effect size (Cohen's f = .25), which yielded a target sample size of 128 participants for .80 power at α = .05.

To be eligible for the study, participants had to be: at least 18 years old, self-identified White/Caucasian, U.S.-born, native English speakers, with no diagnosis of any psychiatric illnesses (e.g., depression, anxiety), and without specific cardiac conditions (e.g., hypertension, heart arrhythmia) or medical complications (e.g., autoimmune disorders, cancer, Parkinson's disease) that could influence cardiovascular responses. Further, participants were not permitted to participate if, at the time of the experiment, there were temporary complicating factors that would compromise acquiring clean heart rate and blood pressure data (e.g., poor sleep, recent illness, and cigarette smoking, caffeine intake, and exercise prior to their participation; for full details of the eligibility criteria, see *Supplementary Materials*). Participants who were ineligible due to such temporary circumstances were invited to reschedule on days when these factors would not apply. Participants who were ineligible were dismissed from the study prior to any sensor setup or data collection and compensated with partial credit for their time.

Procedure

The study lasted one hour (see Figure 1 for the procedure timeline). All protocols and procedures received ethics approval.

First, participants were prepared for physiological recording. After sensor attachment, participants' baseline physiological responses were obtained over a 3-minute period while participants were instructed to sit still and relax in silence. The experimenter left the room while baseline data were collected and returned after three minutes.

Participants were then randomly assigned to one of two experimental conditions—i.e., ingroup-perpetrator condition or outgroup-perpetrator condition. In both conditions, participants read a 5-page story describing a soldier torturing an Iranian prisoner with short breaks in between pages, displayed on a computer screen positioned in front of the participant. Each page of the story was time-limited to control participants' reading time. In the ingroup-perpetrator condition, the soldier was American, whereas in the outgroup-perpetrator condition, the soldier was Australian. The content of this manipulation was adapted from stimuli previously used to make ingroup-perpetrated violence salient in prior research (Leidner et al., 2010; Li, Leidner, & Fernandez-Campos, 2020; Li et al., 2018; Li, Leidner, Petrovic, & Prelic, 2020).

After completing the story, participants were falsely told that there was another participant in a different room, with whom we would like them to meet and discuss the story that they had just read. All participants agreed to proceed with this portion of the experiment. Participants were told that we had video-recorded their interaction partner (a male, Iranian confederate) while he introduced himself and discussed the story that they had just read for two minutes and we wanted them to view this video clip to gain some information about this person prior to meeting him. In the two-minute video clip, the confederate was seated in a chair and

connected to the same physiological sensors to enhance the cover story. He introduced himself as an international student from Iran, noted that he was religiously Muslim, and that he found the story in the study upsetting and distressing. Nevertheless, the confederate was instructed to keep his facial expressions as neutral as possible, so as to avoid potential complications of emotional expressivity.

After watching the confederate's video, participants were asked to introduce themselves and discuss the story while being video-recorded for two minutes. Participants were told that their video would be shown to the confederate. This task constituted the critical phase of the experiment, during which we assessed participants' cardiovascular reactivity to differentiate motivational states of challenge or threat. Afterwards, participants had additional two minutes to mentally prepare for the alleged discussion with the confederate.

Lastly, participants completed a questionnaire assessing different aspects of defensive (i.e., justification, support for militaristic conflict resolution strategies) and non-defensive (i.e., support for diplomatic conflict resolution strategies) reactions to intergroup violence and also completed a demographic questionnaire.

Finally, although participants were led to believe that they would meet with the confederate after completing the questionnaire, no such meeting actually occurred. Participants were probed for suspicion and dismissed. No participants reported disbelief of our cover story.

Measures

Cardiovascular responses. Motivational tendencies of challenge or threat were distinguished using four cardiovascular indices: ventricle contractility [VC], heart rate [HR], cardiac output [CO], total peripheral resistance [TPR]—obtained with electrocardiography (ECG; recorded with an ECG 100C) and impedance cardiography (recorded with a NICO-100C

module), both of which were interfaced with BioPac MP150 hardware (Goletta, CA) with a sampling rate of 1000Hz (see *Supplementary Materials* for sensor setup details). In addition, non-continuous blood pressure was obtained with an inflating cuff placed on the participant's non-dominant arm at specific timepoints during the study (see Figure 1), using Colin Prodigy II (San Antonio, TX).

Signals were scored offline using MindWare HRV 3.0 and MindWare IMP (3.0) from MindWare Technologies (Gahanna, OH) based on 60-second bins. Bins in which cardiovascular data were messy to the point of being impossible to clean were not scored and were instead recorded as missing data. Messy cardiovascular data were characterized either by complete ECG signal loss or by impossible cardiac readings, which occurred when participants did not follow instructions to sit still and avoid large body movements. We extracted pre-ejection period (PEP) as a relatively pure measure of SNS activation and CO as a measure of cardiac efficiency. Following Blascovich and colleagues (2004), we computed VC measures by multiplying PEP by -1 so that higher numbers indicate greater SNS activation. We estimated TPR based on the following formula: (Mean arterial pressure [MAP])/CO)×80 (Sherwood et al., 1990).

To compute reactivity indices for each cardiovascular parameter (VC, HR, CO, and TPR, separately), we first extracted baseline data from the last minute of the initial resting period when participants were most relaxed, following the common procedures in research designs for the assessment of challenge and threat (see Jamieson, Nock, & Mendes, 2012; Chu, Lucas, Lei, Mozgai, Kooshabeh, & Gratch, 2019; Lamarche et al., 2020; Seery, Gabriel, Lupien, & Shimizu, 2016). We then extracted responses from the second minute during the 2-min introduction period, in which participants showed greater stress reactivity. We expected that a stress response would not be elicited immediately after being exposed to the stressor, but it would take some

time to reach its peak level. Consistent with this prediction, VC reactivity was greater in the second minute (*M* = 24.25, *SD* = 20.78) than the first minute (*M* = 9.03, *SD* = 14.17) of the introduction. We thus computed reactivity indices for each cardiovascular parameter by subtracting the last minute of baseline data from the responses from the second minute during the introduction.

As shown in Figure 1, physiological data were also collected during other parts of the study, including the reading task, the confederate's introduction, and the discussion preparation stage. However, cardiovascular responses during these stages were secondary to our main hypothesis, as the introduction was the critical task stage that required the most active (rather than passive) involvement in a motivated performance task—i.e., a necessary condition to assess challenge vs. threat (Blascovich & Mendes, 2000; Mendes & Park, 2014). Consistent with this view, VC reactivity was at its largest during the participant's introduction to the confederate, *M* = 24.96, *SD* = 20.83, compared to any other stage of the experiment (reading task: *M* = -0.27, *SD* = 7.74, F (1, 105) = 175.70, $p < .001$; the confederate's introduction to the participant, *M* = 6.89, *SD* = 12.32, F (1, 105) = 115.93, $p < .001$; the discussion preparation stage, *M* = 11.48, *SD* = 15.66, F (1, 105) = 64.23, $p < .001$).[1] Secondary analyses of relationships between challenge/threat reactivity during these other stages and our outcome variables are reported in *Supplementary Materials*.

Self-report measures. Questionnaire items were identical across conditions, apart from specific references to the United States or Australia. All items were scored on continuous visual analogue scales anchored at 1 and 9, with the exception of one item assessing perceptions of Iran

[1] These statistics were analyzed in SAS 9.4 using a one-way repeated measures ANOVA with planned contrasts between the focal task and all other experiment stages.

as an enemy of the United States, which was scored on a continuous visual analogue scale anchored at 1 and 100.

Support for conflict resolution strategies. Seven items measured support for conflict resolution strategies. Four items were designed to measure participants' support for militaristic conflict resolution strategies (e.g., "The U.S./Australia should prepare itself to use military force if there's any fallout from [the Perpetrator's] actions"). However, one item demonstrated poor inter-correlations with the other three items and thus was excluded from the composite index (M=4.26, SD=1.39, α=.65).[2] Three items measured participants' support for diplomatic conflict resolution strategies (e.g., "The U.S./Australia should send diplomats to Iran to come to an agreement about what to do about [the Perpetrator's] actions;" M=6.73, SD=1.37, α=.82).

Justification. Four items measured participants' justification of the perpetrator's torture of the Iranian detainee (e.g., "Actions like [the Perpetrator's] are understandable, given the situation and pressure that he was likely under," M=3.02, SD=1.47, α=.86).

Perception of Iran as an enemy. One item asked, "To what extent do you believe that Iran is an enemy of the United States?" (M=36.07, SD=18.66).

Self-reported challenge/threat appraisals. Three items, taken from Mendes et al. (2007), were used as self-report measures of perceived demands ("I am very uncertain about how well I will do during the upcoming discussion with the other participant," "The discussion will be very stressful") and resources ("It is important to me that the discussion will go well"). A ratio of self-reported resources-to-demands was computed by dividing the resource item by the average of the

[2] Results did not change depending upon the inclusion or exclusion this item ("The U.S./Australia would be well advised to take a strong stance in order to resolve this situation with Iran"). See *Supplementary Materials* for the results with this item included.

two demand items, such that higher numbers indicated higher self-reported challenge (or lower levels threat), *M*=1.61, *SD*=1.31.

Finally, participants completed a demographics questionnaire, including question items for political affiliation ("When it comes to my political orientation, I am…0 = Liberal/Left; 100 = Conservative/Right"), gender, and age. We administered the item probing political orientation because attitudes towards the outgroup in our design (Iranians) are shown to be more negative among conservatives than liberals among Americans (Pew, 2018), and this pattern could affect our results if our sample had a partisan skew. Other variables were included for exploratory purposes (see *Supplementary Materials*). We do not report the results from these other variables as they were secondary to our key hypotheses.

Results

Data Attrition and Preliminary Analyses

We excluded nine participants (exclusion rate: 6.9%): four participants who were not born in the U.S., two participants whose native language was not English, two participants whose physiological data were unusable, and one participant who exited the study prior to data collection. This resulted in the sample of 121 participants for data analysis (95 female, 25 male, 1 unreported gender). Among this sample, the final analysis was based on 105 participants who had all relevant data (i.e., both cardiovascular and questionnaire data).

Consistent with previous evidence that both challenge and threat states elicit increases in SNS activation (Blascovich & Mendes, 2000), we found a significant increase in VC responses from baseline levels during our focal stage in both conditions (ingroup-perpetrator: *M*=23.89, *SD*=19.64, *t*(56)=9.19, *p*<.001, *d*=1.22; outgroup-perpetrator: *M*=24.64, *SD*=22.13, *t*(52)=8.11, *p*<.001, *d*=1.11), thereby satisfying a necessary condition to differentiate challenge vs. threat

reactivity. VC reactivity did not significantly differ between conditions, $t(108)=0.19$, $p=.852$, $d=.040$. Congruent results were found for HR reactivity: a significant increase above baseline in both conditions (ingroup-perpetrator: $M=24.53$, $SD=12.01$, $t(56)=15.42$, $p<.001$, $d=2.04$; outgroup-perpetrator: $M=26.02$, $SD=15.40$, $t(54)=12.42$, $p<.001$, $d=1.69$), and no significant difference in HR reactivity between conditions, $t(109)= 0.57$, $p=.571$, $d= .036$.

Similar to others who have measured challenge/threat reactivity across multiple contexts (e.g., Seery, Weisbuch, & Blascovich, 2009; Seery et al., 2010; Streamer, Seery, Kondrak, Lamarche, & Saltsman, 2017; Lamarche et al., 2020), we found that TPR reactivity and CO reactivity were strongly negatively correlated, $r(107)=-.74$, $p<.001$, and thus, our primary analysis was based on a single index of challenge/threat reactivity to streamline the results. This single index was computed by subtracting standardized TPR reactivity from standardized CO reactivity, such that higher scores indicated more challenge (or less threat) (for similar approaches, see Blascovich et al., 2004; Seery et al., 2009). Detailed results for each parameter separately are reported in *Supplementary Materials* and did not differ from results for the single index.

Analytic Strategies and Sensitivity Power Analysis

For our main analyses, we conducted a series of multiple linear regressions for each dependent variable (i.e., support for diplomatic conflict resolution strategies, support for militaristic conflict resolution strategies, justification of perpetrator actions, and perceptions of Iran as an enemy of the U.S.). In each regression, we entered main effects of condition (ingroup-perpetrator vs. outgroup-perpetrator) and the challenge/threat index, as well as the interaction

between the two, as predictors of each dependent variable.[3] In addition, we found that our sample was predominantly liberal (*M*=33.11, *SD*=22.63) [0=liberal/left, 100=conservative/right, midpoint=50]), $t(118)=-8.14$, $p<.001$, $d=-0.75$, and thus, to adjust for this sample characteristic, we included political affiliation as a covariate in all analyses, given that liberals and conservatives differ in their attitudes towards the outgroup (Iranians; Pew, 2018). The inclusion of this covariate was not planned *a priori*, but rather was determined during data analysis as a consequence of our sample's significant partisan skew. Results without this covariate (reported in *Supplementary Materials*) were congruent with our reported results, albeit with relatively smaller effects.

For all dependent variables, we expected to find a significant interaction effect between condition and the challenge/threat index, such that the challenge/threat index would be associated with more non-defensive (or less defensive) reactions only in the ingroup-perpetrator condition, but not in the outgroup-perpetrator condition. However, we made no specific *a priori* predictions regarding whether or not there would be main effects of either condition (irrespective of challenge/threat) or the challenge/threat index (irrespective of condition) on the dependent variables.

Since our final sample size fell short of the desirable sample size indicated by *a priori* power analysis, we also conducted a sensitivity power analysis using GPower 3.1.9.2 to determine minimum detectible effect (MDE), accounting for all instances of missing data. On the

[3] Analyses were conducted using PROC GLM in SAS 9.4. This procedure can be used for simple and multiple least-squares regressions, as well as general linear models (GLM), and outputs both coefficient confidence intervals and η_p^2 effect sizes for each term modelled in the regression. We report both measures in all results. Syntax for all analyzes are publicly available and linked in the acknowledgements.

basis of 105 participants, with a desired power of .80 and α=.05, our MDE was Cohen's *f* = .276, or η_p^2 = .071, representing a medium effect size (Cohen, 1988; Lakens, 2013).

Main Analyses

Conflict resolution strategies. We tested our hypotheses in two separate linear regression analyses—one on support for diplomatic conflict resolution strategies and one on support for militaristic conflict resolution strategies. We expected contrasting effects of challenge (vs. threat) on these two outcome variables, such that greater challenge/threat would be associated with greater support for diplomatic conflict resolution strategies, whereas greater challenge/threat would be associated with less support for militaristic conflict resolution strategies, both of which we expected to find in the ingroup-(but not in the outgroup) perpetrator condition.

Support for diplomatic conflict resolution strategies. No main effect of condition was found on support for diplomatic conflict resolution strategies (see Table 1 for statistics for main effects). The main effect of challenge/threat was significant: more challenge (relative to threat) was associated with more support for diplomatic conflict resolution strategies. Importantly, this main effect was qualified by a significant interaction effect, *b* = .346, *SE* = .136, 95% CI[.076, .615], *t*(100)= 2.54, *p*=.013, η_p^2=.061, 90% CI[.007, .144][4], post-hoc observed power = .735. As predicted, greater challenge (relative to threat) was associated with greater support for diplomatic conflict resolution strategies in the ingroup-perpetrator condition, *b*=.394, *SE*=.102, 95% CI[.191, .597], *t*(100)=3.85, *p*<.001 (see Figure 2a), but no such relationship was found in the outgroup-perpetrator condition, *b* = .049, *SE*=.090, 95% CI[-.129, .226], *t*(100)=0.54, *p*=.588.

[4] 90% Confidence intervals are reported for η_p^2 following Lakens (2013).

Support for militaristic conflict resolution strategies. In contrast, there were no significant main effects of condition or challenge/threat on support for militaristic conflict resolution strategies (see Table 1). Further, contrary to our hypothesis, the interaction between the two was also non-significant, b = -.073, SE = .147, 95% CI[-.365, .219], t(100)=-0.50, p=.621, η_p^2=.002, 90% CI[.000, .040].

Justification. The main effects of condition and challenge/threat were non-significant. Yet, as predicted, a significant interaction between the two was found, b = -.329, SE = .149, 95% CI [-.624, -.034], t(100)= -2.21, p=.029, η_p^2=.047, 90% CI[.002, .125], post-hoc observed power = .616. In the ingroup-perpetrator condition, more challenge (relative to threat) was associated with less justification of the torture of the Iranian captive, b=-.264, SE=.112, 95% CI[-.486, -.042], t(100)=-2.36, p=.020 (see Figure 2b). In the outgroup-perpetrator condition, no such relationship was found, b=.065, SE=.098, 95% CI[-.129, .259], t(100)=0.66, p=.508.

Iran as an enemy of the U.S. Neither the main effect of condition nor the main effect of challenge/threat reactivity was significant. Yet, as predicted, a significant interaction between condition and challenge/threat was found, b = -4.34, SE = 1.74, 95% CI[-7.79, -.891], t(100)= -2.50, p=.014, η_p^2=.059, 90% CI[.006, .142], post-hoc observed power = .720. In the ingroup-perpetrator condition, more challenge (relative to threat) was associated with decreased perceptions of Iran as an enemy of the U.S., b=-2.78, SE= 1.31, 95% CI[-5.37, -.182], t(100)=-2.12, p=.036 (see Figure 2c). In the outgroup-perpetrator condition, no such relationship was found, b=1.56, SE=1.15, 95% CI[-.708, 3.83], t(100)=1.37, p=.175.

Self-Reported Challenge/Threat Appraisals

For comparison with physiological data, we conducted parallel analyses using the self-reported challenge/threat appraisal ratio in place of the physiological challenge/threat index, after

controlling for political affiliation. The results showed that the self-reported challenge/threat index had no significant main effects on support for diplomatic policies, $t(114) = 0.04$, $p = .966$, support for militaristic policies, $t(114) = -1.62$, $p = .108$, and justification of perpetrator actions, $t(114) = -1.61$, $p = .111$. No significant interactions with condition qualified these main effects (see *Supplementary Materials* for full statistics). In contrast, we found a significant main effect of self-reported challenge/threat on perception of Iran as an enemy of the United States, b=-3.76, SE=1.54, 95% CI[-6.81, -.717], $t(114) = -2.45$, $p = .016$, $\eta_p^2 = .050$, 90% CI [.005, .124]; however, no significant interaction qualified this effect, $b = -1.11$, $SE = .308$, $t(114) = -0.36$, $p = .719$, $\eta_p^2 = .001$, 90% CI [.000, .029].

Discussion

Cardiovascular Reactivity and Attitudes towards Intergroup Violence

Our goal was to examine whether individual differences in motivational states of cardiovascular challenge predicted (non-)defensiveness toward ingroup-perpetrated violence. For three of our four dependent variables, our main hypothesis was supported: challenge was linked to less defensiveness (e.g., justification of perpetrator actions, identifying the outgroup as an enemy of the ingroup) and greater non-defensiveness (e.g., support of diplomatic policies toward the outgroup regarding the perpetrator's actions) of ingroup- (but not outgroup-) perpetrated transgressions.

While prior research has linked cardiovascular reactivity and personally/self-relevant behavior (e.g., performance; interpersonal interactions), the present research is the first to our knowledge to demonstrate a link between cardiovascular reactivity and self-reported intergroup attitudes. Consequently, these findings connect psychological defensiveness in the context of intergroup violence to the broader literature on physiological stress responses. In particular,

these results contribute to a growing number of studies that examine challenge/threat reactivity based upon social identities rather than individual identities. Previous studies have found that salient contexts for gender identity among women (e.g., Lamarche et al., 2020) or racial/ethnic identity among Black and White participants (Mendes, Blascovich, Lickel, & Hunter, 2002; Mendes et al., 2008) influence the associations between challenge/threat reactivity and outcome variables. Our findings suggest that, in a similar vein, national group identity can influence relationships between physiological reactivity and outcome variables (i.e., psychological defensiveness of the perpetrator's group).

Theoretical conceptualizations of moral disengagement and ingroup-defensiveness hold that moral disengagement strategies (e.g., justifying the perpetrator's actions) are employed so as to avoid aspersions on the morality of the ingroup (Bandura, 1999; Leidner et al., 2015; Shnabel & Nadler, 2008). Consistent with these conceptualizations, our results indicate that defensive responses to ingroup-perpetrated violence (e.g., moral disengagement) represent motivational tendencies toward inhibition/avoidance, manifested at the physiological level. Conversely, more challenge (less threat) was linked to greater support for diplomatic conflict resolution strategies, consistent with the idea of challenge as an approach-oriented activation state. However, we did not find corresponding effects on support for militaristic conflict resolution strategies. One possible explanation for this null effect is that psychological defensiveness of the ingroup (e.g., justification of ingroup-perpetrated violence) may represent a distinct phenomenon from tangible aggression toward the outgroup (e.g., supporting military action against it). Yet, this possibility is purely speculative and should be investigated further in subsequent research.

Crucially, any associations between challenge/threat reactivity and intergroup attitudes were specific to the ingroup-perpetrator condition. This specificity suggests that while

participants exhibited task engagement (indexed by increased SNS activation) during their introduction to the confederate in both conditions, this reactivity was only *relevant* for participants' psychological defensiveness of the perpetrator group when the perpetrator was a member of their ingroup (i.e., American soldier), but not when he was a member of an outgroup (i.e., Australian soldier). In other words, only when the context was personally relevant to participant's group-based social identity as Americans, participants' physiological stress reactivity in anticipation of interacting with a member of the victimized outgroup was significantly associated with their defensive or non-defensive reactions to their own group's transgressions. These results are consistent with previous findings that challenge/threat patterns of cardiovascular reactivity predicted performance outcomes only when these motivational states were assessed while participants engaged in a goal-relevant (vs. irrelevant) task— i.e., giving a speech on the topic immediately related to participants' goal on athletic (Blascovich et al., 2004) and academic performance (Seery et al., 2010)—and thus the stressor was contextually relevant to participants. Similarly, our results suggest that shared national identity with the perpetrator created a distinct self-relevant, group identity-based stressor when anticipating an interaction with a member of the victimized group, whereas without this shared identity, the stressor was irrelevant to the participant as a member of their national group.

Notably, when we analyzed the self-reported challenge/threat ratio, this variable did not significantly interact with condition to predict any outcome variables. The fact that cardiovascular measures of challenge and threat were uniquely associated with differences in psychological defensiveness of ingroup-perpetrated violence implies that psychophysiological research may help clarify ambiguities that are impossible to resolve in studies with self-report measures only. Cardiovascular responses may be more sensitive than the self-report measure of

demand and resources to capture the appraisal mechanisms driving the motivational states of challenge/threat, which might occur outside of conscious awareness (Blascovich & Mendes, 2000; Seery, 2013; Mendes & Park, 2014). This result is also in line with prior psychophysiological research that similarly found the lack of convergence between self-reported demand and/or resource appraisals and cardiovascular measures of challenge/threat (Blascovich, Mendes, & Seery, 2002; Turner, Jones, Sheffield, & Cross, 2012; Akinola & Mendes, 2014; for a review, see Seery, 2013).

Broader Implications for the Psychology of Intergroup Violence

Connecting stress appraisals to how people respond to ingroup-perpetrated violence facilitates a more nuanced understanding of how and when people are psychologically defensive or non-defensive of violence perpetrated by their ingroup. Owing to near-constant media coverage, ingroup-perpetrated violence may be difficult or impossible to ignore as a salient stressor, and how people respond to that stressor carries implications for what types of resolutions they may support. The needs-based model of intergroup reconciliation (Shnabel & Nadler, 2008; Shnabel, Halabi, & Noor, 2013) holds that members of victimized groups have a need for recognition of their suffering and for re-empowerment. Responding to the stressor of being connected to a perpetrator group with moral disengagement (e.g., defensively; Bandura, 1999) effectively denies this need to members of victim groups, whereas non-defensive responses (e.g., diplomatic conflict resolution strategies, admission of responsibility and culpability) supports these needs (Shabel & Nadler, 2008; Leidner et al., 2010). Measuring physiologically-indexed motivational states that occur outside of conscious awareness can help shed light on how members of perpetrator groups process the stress of interacting with members of the harmed group. These insights can facilitate understanding of how members of perpetrator

groups can manage that stress to most effectively meet the psychological needs of members of victim groups, potentially helping to promote efforts at reconciliation.

Critically, our findings suggest that non-defensive coping mechanisms for social identity stressors (such as anticipating an interaction with a member of a group that one's own group has harmed) may be less psychologically costly than previously believed (see Leidner et al., 2015). Previous evidence links non-defensive coping with ingroup-perpetrated violence to guilt and shame (Aquino et al., 2007) and to ostracism by ingroup members (Leidner et al., 2015), suggesting that psychologically defensive responses function to avoid these consequences. Our results challenge this framework by demonstrating that non-defensive responses are associated with cardiovascular responses of challenge, which reflect healthier cardiac functioning compared to threat responses (Blascovich, 2008; for a review, see Mendes & Park, 2014). These patterns suggest that, rather than incurring additional distress or physiological strain in order to respond as they do, participants who respond non-defensively do so from a resilient position. Other research has generated concordant findings that White participants low in racial bias display healthier hormonal profiles in response to interracial interactions (Mendes, Gray, Mendoza-Denton, Major, & Epel, 2007). Thus, while there may be short-term costs of non-defensive reactions, their association with challenge states suggests that these reactions may reflect psychophysiological fortitude to acknowledge wrongdoings.

Limitations and Future Directions

Several future research directions warrant discussion, some of which stem from the limitations of the current work. First, our results are based on a mostly female, ethnically homogenous sample of White university students in the American Northeast, who lean, on average, to the political left. A related limitation is that this study was conducted within a very

specific context of intergroup conflict (i.e., U.S.-Iran relations). Consequently, replication in other cultures and contexts, and with more representative samples, is warranted. Moreover, while the sample size and post-hoc power of our effects are comparable to those of other relatively recent psychophysiological studies on cardiovascular challenge and threat (e.g., Lamarche et al., 2020; Streamer et al., 2017; Seery, Gabriel, Lupien, & Shimizu, 2016), our effects were nevertheless slightly below the minimum detectible effect (MDE) suggested by a sensitivity power analysis. This occurred partly because the effect sizes we observed were slightly smaller than the medium effect size we assumed when conducting *a priori* power analysis for this study. Thus, future research should not only aim to replicate these findings with more representative samples, but also to recruit larger sample sizes, both in anticipation of small-to-medium effects and to safeguard against power loss due to unusable cardiovascular data.

Beyond higher-powered and more representative replications, future research building upon these findings should consider how the link between challenge/threat states and attitudes toward ingroup-perpetrated violence that we observed can be elaborated upon and applied. One particular direction that would be important to pursue is to examine how challenge/threat might shape an interaction with members of a victimized group, when participants are categorized into one of newly created groups using a minimal group paradigm (for a review, see Otten, 2016). This direction would allow for the phenomenon to be examined outside of the sociopolitical context in which our results were found, extending our theory by examining whether merely sharing a social group (a) elicits challenge/threat reactivity at all, and (b) whether this reactivity is associated with attitudes towards a (minimal) outgroup.

A second, more applied direction is to examine the role that specific emotion regulation strategies could play in shaping motivational states of challenge and threat in response to

ingroup-perpetrated violence. Prior research has found that emotion suppression (i.e., suppressing emotional expressivity) and reappraisal (i.e., re-interpreting an emotional stimulus toward a particular direction; see Gross, 1998) can influence challenge/threat reactivity (Peters & Jamieson, 2016; Jamieson, Crum, Goyer, Marotta, & Akinola, 2018). Reappraisal in particular has been observed to re-orient cardiovascular reactivity from threat toward more challenge-oriented responses (Jamieson, Nock, & Mendes, 2012; Jamieson, Mendes, & Nock, 2013; for a review, see Jamieson et al., 2018). Building on this evidence, a follow-up study could investigate whether instructing participants to reappraise their reaction to ingroup-perpetrated violence as a challenge (rather than threat) would lead to less psychological defensiveness. However, there is also evidence that in some circumstances (e.g., prisoner's dilemma paradigms), emotion reappraisal instructions can elicit greater *threat*, rather than challenge (Chu et al., 2019), so any future work should also be cognizant of this possibility.

Concluding Remarks

The present research is the first to associate physiologically-indexed motivational states of challenge and threat with intergroup attitudes more broadly. By doing so, we integrate the biopsychosocial model of challenge and threat with literature on the psychology of intergroup violence. We specifically found that when participants are faced with the stressor of interacting with a member of a group that someone from their own group perpetrated harm against, greater cardiovascular challenge (less threat) is associated with less psychological defensiveness and more support for diplomatic solutions. This study therefore provides a critical first step at disambiguating how people respond when their group perpetrates harm upon members of another.

Conflict of Interest Statement

No conflicts of interest are declared.

Author's Note: This research was funded through a joint grant from the National Science Foundation and the Binational Science Foundation (NSF BCS-1628458; BSF 2016859).

Acknowledgements

The research conducted in this brief report was made possible by funding through a joint grant though the National Science Foundation and the Binational Science Foundation (NSF BCS-1628458; BSF 2016859). The method for this study followed the proposals outlined in this grant. Further, the authors wish to briefly acknowledge the work that undergraduate research assistants performed during data collection by administering the protocol to participants.

The raw data and SAS syntax for this study are online available at: https://www.openicpsr.org/openicpsr/project/116809/version/V3/view

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Table 1a
Main Effects of Condition

	$M_{ingroup}$ (*SD*)	$M_{outgroup}$ (SD)	*b* (*SE*)	95% CI	*t*(100)	*p*	η_p^2	90% CI
Diplomatic conflict resolution strategies	6.92 (1.35)	6.51 (1.31)	.256 (.239)	[-.219, .731]	1.07	0.288	0.011	[.000, .066]
Militaristic conflict resolution strategies	4.47 (1.36)	4.12 (1.30)	.434 (.259)	[-.080, .948]	1.67	0.098	0.027	[.000, .095]
Justification of Perpetrator Actions	2.90 (1.43)	3.09 (1.46)	-.070 (.262)	[-.590, .449]	-0.27	0.789	0.001	[.000, .027]
Iran as an Enemy of the U.S.	35.77 (17.89)	35.79 (17.56)	1.32 (3.06)	[-4.75, 7.39]	0.43	0.667	0.002	[.000, .037]

Table 1b
Main Effects of Challenge/Threat Index

	b (*SE*)	95% CI	*t*(100)	*p*	η_p^2	90% CI
Diplomatic conflict resolution strategies	0.221 (.068)	[.087, .356]	3.26	0.002	0.096	[.023, .188]
Militaristic conflict resolution strategies	-0.066 (.074)	[-.212, .080]	-0.90	0.369	0.008	[.000, .058]
Justification of Perpetrator Actions	-0.099 (.074)	[-.247, .048]	-1.34	0.185	0.018	[.000, .078]
Iran as an Enemy of the U.S.	-0.607 (.869)	[-2.33, 1.17]	-0.70	0.487	0.005	[.000, .049]

Figures

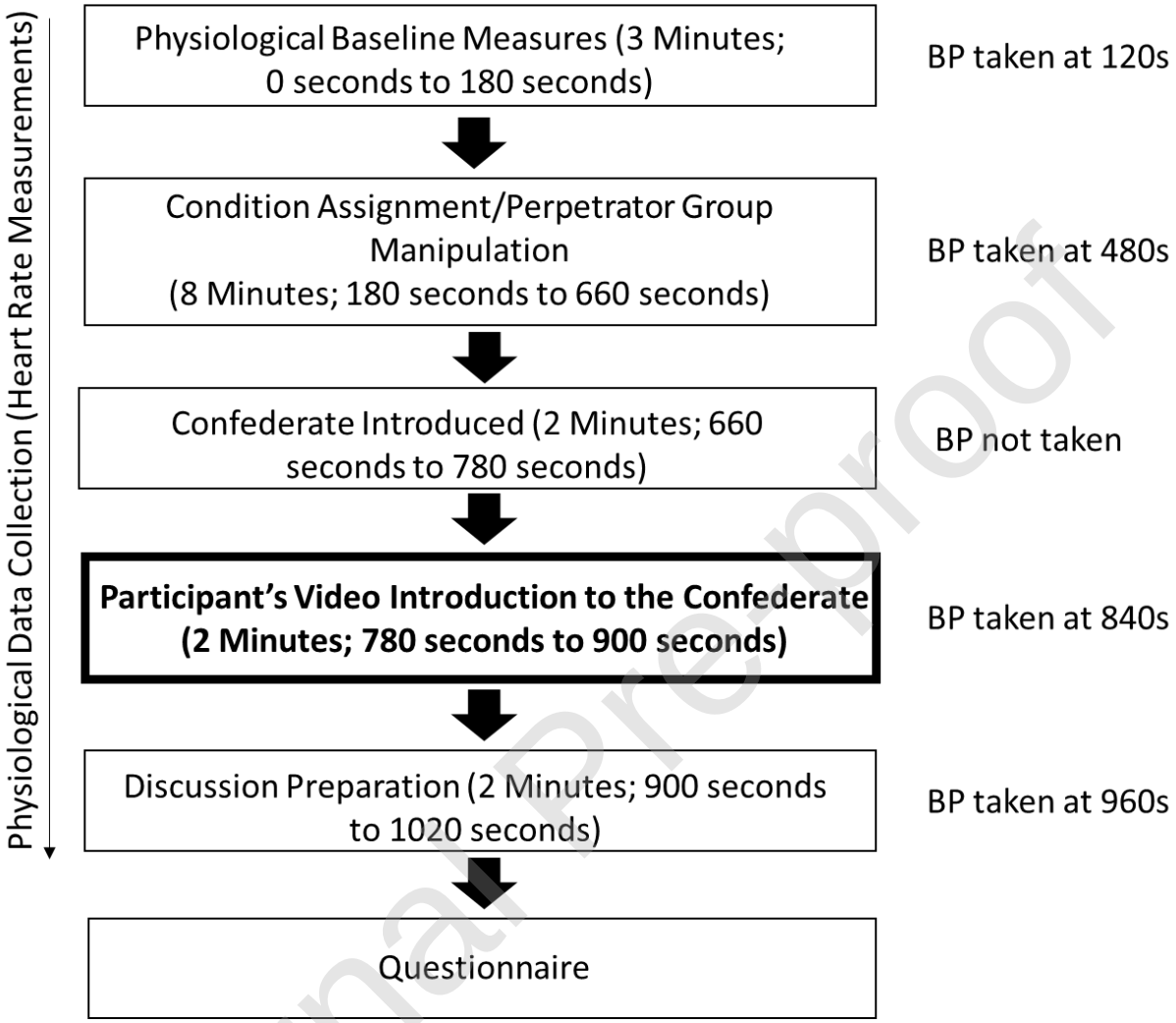

Figure 1. Timeline of experimental procedure. The focal stage of the experiment, during which VC reactivity was at its peak, is bolded. All main analyses involving the challenge/threat ratio presented in the main manuscript are based on reactivity during this stage (for secondary analyses involving other stages, see *Supplementary Materials*). The exact time point (in seconds) at which blood pressure measurements were taken (if applicable) is indicated to the right of each stage.

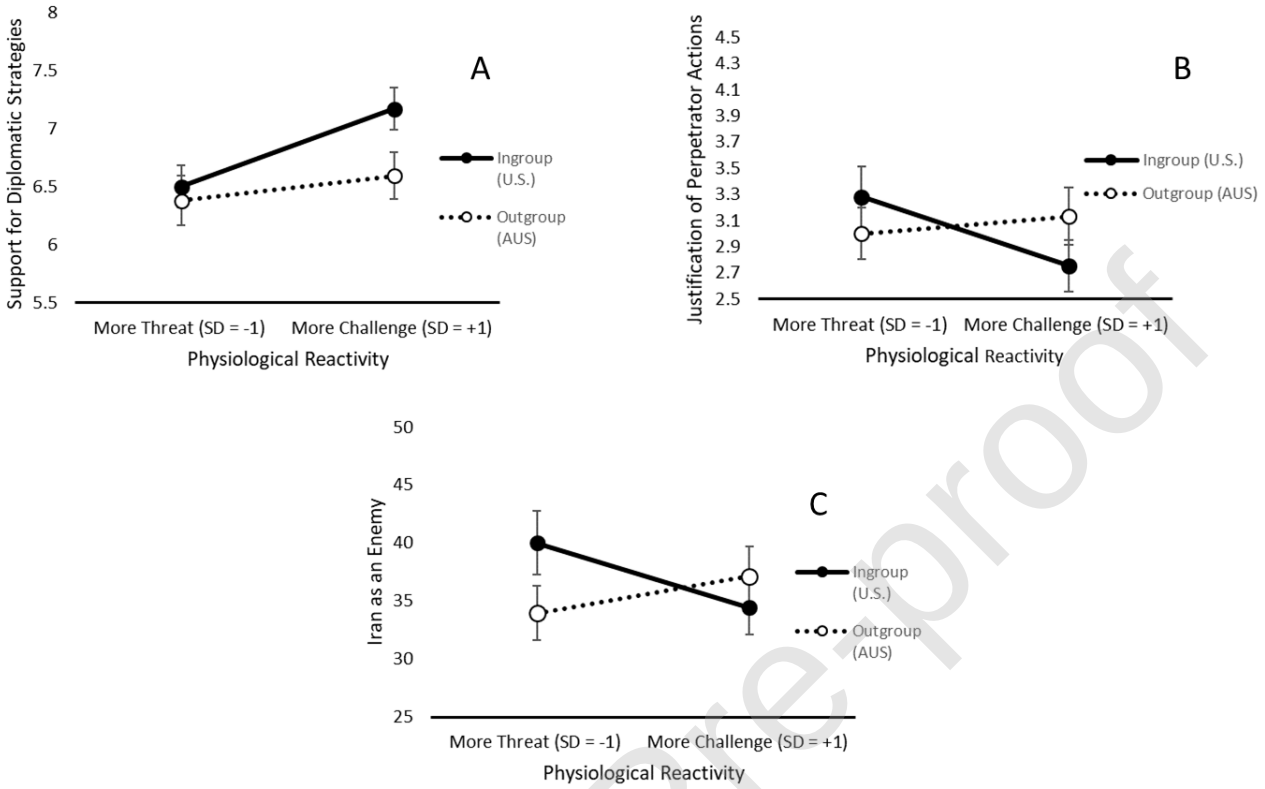

Figure 2. Support for diplomatic strategies (a), justification of perpetrator actions (b) and perceptions of Iran as an enemy (c) as a function of CT reactivity. In the ingroup condition only, greater challenge was associated with more support for diplomatic conflict resolution strategies, less justification of perpetrator actions, and weaker perceptions of Iran as an enemy. Circles indicate least-square means of condition at relative threat and challenge levels (controlling for political affiliation). Error bars represent standard error.