Reducing Cultural Mismatch: Latino Students' Neuroendocrine and Affective Stress Responses Following Cultural Diversity and Inclusion Reminder

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Abstract

Cultural mismatch theory suggests that a poor fit between the cultural values endorsed by individuals and the institutions to which they belong results in emotional distress and activation of physiological stress processes, particularly for underrepresented groups. To test a novel paradigm for reducing perceptions of this cultural mismatch, the current experiment evaluated whether reminding first-year Latino university students (N = 84; M_{age} = 18.56; SD = 0.35; 63.1% female; 85.7% Mexican descent; 65.5% first-generation college students) about institutional support for cultural diversity and inclusion would reduce neuroendocrine and affective responses to psychosocial stress. Prior to completing a modified version of the Trier Social Stress Test, participants were randomly assigned to view either a video conveying university commitment to cultural diversity and inclusion (n = 45) or a control video (n = 39) depicting a campus tour. Five saliva samples assayed for cortisol and corresponding negative affect measures were collected to assess stress reactivity and recovery patterns (pre-task baseline, post-task +30 min, +45 min, +60 min, +75 min). Repeated measures data were analyzed using bilinear spline growth models. Viewing the culture video (compared to control) significantly reduced cortisol reactivity to the TSST and post-task negative affect levels, specifically for students endorsing higher Latino cultural values (e.g., familism, respect). Post-task cortisol levels were also reduced for students endorsing higher U.S. mainstream cultural values (e.g., self-reliance, competition). Results provide novel evidence for cultural diversity in stress responsivity and individual variation in approaches to reduce perceived cultural mismatch.

Keywords: *Latino*, *adolescents*, *college*, *culture*, *stress*, *cortisol*, *reactivity, cultural mismatch, values*

Introduction

Despite significant gains in college access, U.S. Latino[1] young adults remain less than half as likely as non-Latino White young adults to attain a bachelor's degree, a gap that has persisted in the last 20 years (McFarland et al., 2018). This educational inequity has negative implications for the future health and well-being of Latino adolescents and young adults, who are expected to comprise 30% of the U.S. population in the next 40 years (Colby and Ortman, 2014). Among myriad factors contributing to this disparity (Davis-Kean et al., 2012), *cultural mismatch theory* suggests that poor fit between values held by underrepresented (i.e., first-generation, ethnic-racial minority) students and those of higher education institutions produces distress and physiological stress responses (Stephens et al., 2012a, 2012b, 2019), with potentially long-term health implications. Though many colleges and universities are evolving to address a lack of cultural diversity and improve inclusion (Garcia and Serrata, 2016), few studies have evaluated the acute physiological and psychological effects of efforts to reduce perceptions of cultural mismatch. The current study used an experimental design to test whether a university-sanctioned message in support of cultural diversity and inclusion would reduce first-year Latino students' neuroendocrine and affective responses to psychosocial stress.

Many Latino students routinely face an array of stressors on university campuses, including harmful microaggressions that contribute to feelings of not belonging and other forms of discrimination (Yosso et al., 2009; Zeiders et al., 2018). The resulting physiological responses to such challenges have been theorized as mechanisms through which psychosocial stress contributes to broader ethnic-racial disparities in health (e.g., cardiovascular risk; Myers, 2009)

[1] "Latino" is used here to refer to an individual residing in the U.S. with family ancestry in a Spanish-speaking country in Latin America, the Caribbean, and parts of the U.S. that were formerly territories of Spain or México (Gonzales, Germán, & Fabrett, 2012).

and education (Heissel et al., 2017). As one of the body's major stress response systems, the hypothalamic-pituitary-adrenal (HPA) axis releases the steroid hormone cortisol as part of a multi-system stress response cascade (de Kloet, 2004). In addition to serving as a marker of the HPA axis stress response, cortisol is involved in daily biological function (Lovallo, 2005), including a feedback loop to regulate the more immediate and energy-consuming sympathetic nervous system response (Sapolsky et al., 2000). Cortisol also aids in mobilizing the body's resources in response to stressors involving social evaluation (Dickerson and Kemeny, 2004), like those faced by many Latino students on predominantly White college campuses (Zeiders et al., 2018). Based on findings from a meta-analysis of psychosocial stress studies, Dickerson and Kemeny (2004) have argued that the magnitude of the HPA stress response is influenced by the extent to which individuals' sense of "social self" (i.e., their social value and status based on other's perceptions of their worth) is threatened. Although acute cortisol reactivity to these types of threats can serve an adaptive function in the short term, repeated or exaggerated activation of the HPA axis and downregulation of other response systems over time can contribute to allostatic load, a physiological burden resulting in elevated risk for chronic health problems (e.g., hypertension, depression; McEwen, 2004; Miller et al., 2007). Heightened affective reactivity to stress is also implicated in risk for mental and physical health problems (Pascoe and Smart Richman, 2009). Some evidence indicates affective responses to stress are unrelated to HPA responses (e.g., Roy, 2004), suggesting this affective pathway may be distinct from physiological reactivity.

Institutional cultural barriers facing Latino and other underrepresented college students likely play a unique role in activating and/or maintaining stress responses (Stephens et al., 2012a, 2012b). Researchers have explored several possibilities for reducing cortisol reactivity to social

stress for ethnic-racial minority or first-generation students, such as by affirming students' personal values (Creswell et al., 2005), encouraging self-reflection (Tsai et al., 2016), and priming interdependent rather than independent cultural norms (Stephens et al., 2012b), though none of these studies focused on Latino students, specifically. In studies of Latinos, which conversely did not include physiological measures, affirming interdependent values improved performance on a verbal reasoning task (Covarrubias et al., 2016) and self-affirmation writing exercises improved adolescents' academic trajectories up to 3 years later (Sherman et al., 2013). This process of self-affirmation theoretically protects against threats to sense of self by enabling individuals to appraise stressors in reference to a larger context after remembering what matters most to them (Cohen and Sherman, 2014).

Beyond the individual level, institutions play a critical role in this affirmation process for adolescents transitioning to college. According to *cultural congruity theory* (Gloria and Robinson, 1996), it is not only Latino students who must culturally adapt, but universities too that carry responsibility for creating culturally welcoming environments. Indeed, youth of color have better cardiometabolic health (e.g., lower inflammation) if they attend schools that value ethnic-racial diversity (Levine et al., 2019). In the current study, we tested a novel approach to reduce perceptions of cultural mismatch among Latino college students during the critical juncture of their first semester. Following cultural mismatch (Stephens et al., 2012a) and self-affirmation theories (Cohen and Sherman, 2014) and prior research (Levine et al., 2019; Stephens et al., 2012b), we theorized that reminding Latino students of university commitment to cultural diversity and inclusion would buffer against threats to sense of self during socially evaluative stress, and thereby reduce cortisol and affective stress responses.

Perceptions of these university efforts are not expected to have the same impact for all Latino students, who comprise a diverse group with varying cultural orientations (Davis-Kean et al., 2012; Gonzales et al., 2012). In a dual cultural adaptation process, Latinos acquire knowledge and values of U.S. mainstream culture (i.e., importance of competition, succeeding as individual) *and* their heritage culture (i.e., sense of family obligation, making family proud; Gonzales et al., 2004). Studies from a growing research field termed *cultural neurobiology* have shown that individual differences in these cultural orientations are related to stress response patterns (see Doane et al., 2018a, for review). For example, Latino adolescents with stronger alignment to U.S. mainstream and Latino heritage cultures exhibited more efficient cortisol recovery from a psychosocial lab stressor (Gonzales et al., 2018). In other studies, Latino adolescents and adults with higher (compared to lower) familism values tended to exhibit lower cortisol levels in the context of everyday stress (Sladek et al., 2019) and lower average cortisol responses to a lab stressor (Campos et al., 2018), respectively. Further, it has been suggested that cultural orientations (e.g., individualistic vs. collectivistic) likely moderate how self-affirmation influences threat reactions (Badea and Sherman, 2019). Thus, we hypothesized that the effects of our approach to reduce perceived cultural mismatch would vary by Latino students' cultural values. Specifically, we expected effects would be more pronounced for students who endorsed higher heritage cultural values (e.g., familism, respect) due to greater perceived mismatch with mainstream institutional values.

Method

Participants

Participants were recruited from a larger longitudinal study of 209 Latino students admitted to a large university in the southwestern U.S. (see Doane et al., 2018b). A subsample

was recruited for a follow-up study during their first university semester. Sample size was determined based on prior studies of similar stress reactivity tasks (e.g., Campos et al., 2018; Stephens et al., 2012b; Tsai et al., 2016) and review of meta-analysis on anticipated effect sizes for this task (Dickerson & Kemeny, 2004). Of 85 recruited participants, one opted out of stress measures and was not included in analyses ($N = 84$; $M_{age} = 18.56$; $SD = 0.35$; 63.1% female). Most participants (85.7%) were of Mexican descent, 10.7% were South or Central American, 3.6% Cuban, and 3.6% were from other Latino groups (e.g., Puerto Rican, Chilean, Dominican, Peruvian, Spanish). Regarding immigrant generation, 11.9% were first-generation (i.e., born outside U.S.), 64.3% were second-generation (i.e., at least one parent born outside U.S.), and 23.8% were third-generation or above (i.e., both parents born in U.S.). Most participants (65.5%) were first-generation college students (i.e., neither parent completed bachelor's degree). This subsample did not differ significantly from the larger sample with respect to gender, Latino subgroup (e.g., Mexican descent vs. other Latino groups), immigrant generation, or parents' education levels, $ps > .237$.

Procedure

The university Institutional Review Board approved all procedures. Participation occurred in the afternoon (starting 1:30 PM or 4:00 PM) to control for diurnal cortisol patterning. Participants were instructed to avoid exercising, eating, or drinking besides water in the hour prior to the study. An experimenter obtained written consent and allowed participants to adjust to the testing room for 15 min before recording baseline measures. Following this acclimation period, participants provided the first of 5 saliva samples via passive drool, followed by the first of 5 corresponding state affect measures (pre-task baseline, post-task +30 min, +45 min, +60 min, +75 min).

After baseline measures, participants completed a modified version of the Trier Social Stress Test (TSST; Kirschbaum et al., 1993), selected because this psychosocial stressor consistently activates the HPA response (Dickerson and Kemeny, 2004) and reflects the mainstream cultural expectations of many college-related experiences (Stephens et al., 2012b). Participants were asked to prepare a 5-min speech about why they are uniquely qualified for a university student award and how their qualifications align with the goals of [*this university*]. Participants were informed they would give this speech in front of student experts who would video record their performance, and they could receive a $10 bonus if positively evaluated. Participants randomly assigned to the *culture* condition (n = 45) then viewed a brief video (2 min, 19 sec) produced by the university that emphasized culture, diversity, and inclusion on campus. The video featured students of diverse cultural backgrounds offering affirming anecdotes in line with the university's inclusive mission, such as, "[*This university*] is measured not by whom we exclude, but rather by whom we include and how they succeed." Students randomly assigned to the *control* condition (n = 39) watched a video of similar style and length featuring a voice-narrated campus tour. Participants were not aware of the experimental design and all other aspects of the task were consistent across conditions.

After a 5-min preparation period, the experimenter left the room and expert judges (one female and one male research assistant) entered. Judges were trained in conducting the TSST, described in detail elsewhere (Dickerson and Kemeny, 2004; Kirschbaum et al., 1993). Judges were blind to condition. Following the 5-min speech, participants completed a 5-min sustained attention allocation task while seated at a computer and monitored by the judges, selected to introduce a cognitive challenge to the social evaluation that was not conflated with math ability (Dickerson and Kemeny, 2004). After the task, participants completed remaining saliva samples

and affect measures (immediately post-task and 15-, 30-, and 45-min post-task) and a questionnaire. After measures were completed, participants were thoroughly debriefed regarding the study design and received $35 (including the $10 bonus).

Measures

Manipulation check. As a check of the stress task, responses to the question, "How stressed do you feel right now?" (1 = *not at all* to 6 = *extremely*) significantly increased from baseline (M = 2.24; SD = 1.08) to post-task (M = 3.27; SD = 1.42), $t(83) = 7.50$, $p < .001$, d = 0.84 (large effect), and perceived stress did not differ significantly by condition, ps > .634. After viewing the video and prior to the task, participants responded to two statements: "[*This university*] is a diverse and inclusive place" and "[*This university*] cares about students of all cultural backgrounds" (1 = *strongly disagree* to 6 = *strongly agree*), $r(82) = .68$, $p < .001$. The mean of these two items was used as a check of the experimental manipulation. On average, watching the culture video (M = 5.40; SD = 0.66) did not significantly increase agreement with these statements compared to the control group (M = 5.31; SD = 0.68), $t(82) = 0.63$, $p = .53$. The average responses for both groups fell between *agree* and *strongly agree*, suggesting a ceiling effect.

Salivary cortisol. Saliva was stored at -80C. Samples were sent by courier on dry ice over no more than 3 days to Biochemisches Labor at the University of Trier in Germany for assay. Samples were assayed for cortisol in duplicate using a competitive solid phase time-resolved fluorescence immunoassay with fluorometric endpoint detection (DELFIA; Dressendörfer et al., 1992). The inter-assay (7.1% to 9.0%) and intra-assay (4.0% to 6.7%) coefficients of variation were acceptable. Cortisol values (nmol/L) were natural log transformed due to positive skew (ICC = .642)

Negative and positive affect. Following each saliva sample, participants completed the Positive and Negative Affective Schedule (PANAS; Watson et al., 1988). The average of ten items assessed state negative affect (NA; e.g., "distressed," "upset"; αs: .76 to .93 across measurement occasions), and the average of ten items assessed state positive affect (PA; e.g., "excited," "enthusiastic"; αs: .88 to .93 across measurement occasions; from 0 = *very slightly or not at all* to 4 = *extremely*). A square root transformation was applied to NA scores due to positive skew (NA ICC = .420; PA ICC = .683).

Cultural values. The 50-item Mexican American Cultural Values Scale (Knight et al., 2010) assessed the extent to which participants endorsed Latino heritage cultural values (familism, respect, religiosity, traditional gender roles; e.g., "Parents should teach their children that the family always comes first"; 36 items; α = .96) and U.S. mainstream cultural values (independence and self-reliance, competition and personal achievement, material success; e.g., "Parents should encourage children to do everything better than others"; 14 items; α = .90; from 1 = *not at all* to 5 = *completely*). The measure was originally developed for Mexican Americans and has been used reliably with other Latino groups (Corona et al., 2017; Sladek et al., 2019).

Covariates. Given significant associations with cortisol levels, participants' sex (1 = male; 0 = female), time since waking (hours), oral contraceptive use (1 = using, *n* = 6; 0 = not using), and living situation (1 = living at home, *n* = 21; 0 = living in university housing) were included as covariates. Given significant associations with affect measures, participants' sex, immigrant generation (0 = participant, both parents, and both sets of grandparents born outside U.S. to 7 = all born in U.S.; Doane et al., 2018b), and depressive symptoms (CES-D scale; Radloff, 1977) were included as covariates. Other variables were evaluated based on prior research (Dickerson and Kemeny, 2004; Stephens et al., 2012b), including parents' education

levels, corticosteroid medication use (n = 10), body mass index, high school grades, and general perceived stress levels reported at the first study assessment prior to college (four-item short form of the Perceived Stress Scale; Cohen & Williamson, 1991). These variables were not significantly associated with outcomes and thus not included in final models.

Analytic Strategy

Descriptive statistics were reviewed to identify statistical outliers[2], and zero-order correlations were reviewed to select covariates. Two-level bilinear spline growth models were used to estimate average post-task levels (i.e., intercepts), and reactivity and recovery trajectories (i.e., slopes) of cortisol, NA, and PA (Grimm et al., 2017; Ram & Grimm, 2007). This approach has several strengths for modeling stress response patterns: (1) multilevel growth models improve statistical power (Maas & Hox, 2005) compared to change score analysis; (2) mean levels, reactivity change rates, and recovery change rates are simultaneously estimated based on multiple sampling occasions, including associations among these patterns, thereby modeling the temporal dynamics of several features of stress responsivity; (3) average patterns (i.e., fixed effects) and individual differences in those patterns (i.e., random effects) are accounted for; and (4) any baseline differences due to time of day, experiences prior to the lab task, or individual differences in HPA function are accounted for in the modeling strategy (see also Bendezú and Wadsworth, 2018; Hostinar et al., 2014; Ji et al., 2016).

First, reactivity and recovery trajectories were modeled at Level 1 using time relative to a knot point that reflected peak stress response for the respective outcome measures (0 = 3rd cortisol sample 15-min post-task; 0 = 2nd affect measure immediately post-task). For example,

[2] Cortisol values from one participant and affect scores from two participants were statistical outliers (> 3 *SD*s above time-specific means). Model results were consistent with or without excluding these data, and thus were retained in final analyses.

cortisol reactivity was modeled with a parameter for "time until 3rd sample" collected 15-min post-task, and cortisol recovery was modeled with a parameter for "time since 3rd sample." Next, experimental condition (1 = culture, 0 = control), cultural values (grand mean centered), and interactions between condition and cultural values were entered as Level 2 (person-level) predictors of post-task levels (i.e., intercepts) and stress response trajectories (i.e., slopes) with significant between-person variance. Latino and mainstream cultural values were tested in separate models due to their related but distinct dimensionality (Knight et al., 2010) and modest correlation in the present study, $r = .26$, $p = .016$. Finally, covariates significantly correlated with dependent variables were added at Level 2. Model results were consistent with and without covariates. Models were fit in M*plus* version 8.1 (Muthén and Muthén, 2017) using maximum likelihood estimation with robust standard errors.

Results

Cortisol Responses to Psychosocial Stress

Based on descriptive statistics, cortisol increased from baseline to the 3rd sample collected 15-min post-task (i.e., 30-min post-stressor onset) for 68.7% of participants and decreased 30 min thereafter for 95.2% of participants (Table 1). Compared to an unconditional model that posits no changes, a bilinear spline model fit the cortisol data significantly better, $\chi^2(2) = 101.38$, $p < .001$.[3] Regarding the average change pattern, cortisol significantly increased from baseline (i.e., reactivity slope estimate) until reaching the peak of approximately 5.124 nmol/L 15 min after the task (i.e., intercept estimate), and then cortisol significantly decreased thereafter (i.e., recovery slope estimate; Table 2, Model 1). There was significant between-person variance in reactivity slopes, $\chi^2(2) = 150.90$, $p < .001$, but not recovery slopes, $\chi^2(2) =$

[3] Adding pre- and post-knot squared terms (i.e., quadratic effects) did not fit the cortisol data significantly better than the bilinear model, $\chi^2(2) = 2.72$, $p = .257$, and were thus not retained in analyses.

0.59, $p = .745$. Reactivity slopes were significantly associated with post-task levels (intercept-slope covariance = 0.004, $p < .001$).

On average, experimental condition did not significantly predict differences in cortisol reactivity or post-task cortisol levels (Table 2, Model 1; Figure 1). Latino cultural values significantly moderated the effect of condition on cortisol reactivity slopes (Table 2, Model 1), accounting for 9.7% of the between-person variance in cortisol reactivity slopes. For participants scoring 1 *SD* above the mean of Latino cultural values (14.3% of sample), the culture condition significantly reduced the rate of cortisol reactivity (compared to control), $b = -0.013$, $p = .008$ (Figure 2). In contrast, for participants scoring 1 *SD* below the mean of Latino cultural values (16.7% of sample), the culture condition did not significantly reduce the rate of cortisol reactivity, $b = 0.002$, $p = .541$.

In a separate model, mainstream cultural values also significantly moderated the effect of condition on post-task cortisol levels (Table 2, Model 2), accounting for 12.2% of the between-person variance in post-task cortisol levels. The culture condition significantly reduced post-task cortisol levels (compared to control) for participants scoring 1 *SD* above the mean of mainstream cultural values (14.3% of sample), $b = -0.407$, $p = .013$, but not for participants 1 *SD* below the mean (14.3% of sample), $b = 0.099$, $p = .542$ (Figure 3).

Negative and Positive Affect Responses to Psychosocial Stress

NA increased from baseline to the 2nd measure collected immediately post-task for 89.3% of participants and decreased 45 min thereafter for 90.4% of participants (Table 1). A bilinear spline model fit the NA data significantly better than an unconditional model, $\chi^2(2) = 229.64$, $p < .001$, and adding a fixed effect for recovery squared (*time since 2nd measure*^{2}) fit the data significantly better than the bilinear model, $\chi^2(1) = 56.47$, $p < .001$. Regarding the average

change pattern, NA significantly increased from baseline until immediately after the task, and then significantly decreased thereafter (Table 3, Model 1). There was significant between-person variance in linear recovery, $\chi^2(2) = 10.26$, $p = .006$, but not reactivity or quadratic recovery slopes, ps > .119.

Condition, Latino cultural values, and mainstream cultural values were not significantly associated with differences in post-task NA or NA recovery (Table 3; Figure 1). Latino cultural values significantly moderated the effect of condition on post-task NA, accounting for 5.9% of the between-person variance in post-task NA, but not rate of NA recovery (Table 3, Model 1). The culture condition significantly reduced post-task NA for participants with higher Latino cultural values, $b = -0.171$, $p = .047$, but not for participants with lower levels of these values, $b = 0.097$, $p = .261$ (Figure 2). Mainstream cultural values did not significantly moderate effects of condition on post-task NA or rate of recovery (Table 3, Model 2).

PA decreased from baseline to post-task for 69.0% of participants and continued to decrease 45 min thereafter for 61.4% of participants (Table 1). A bilinear spline model for PA fit the data significantly better than the unconditional model, $\chi^2(2) = 66.66$, $p < .001$, but adding a fixed effect for recovery squared did not fit significantly better, $p = .450$. Condition, Latino cultural values, and mainstream cultural values were not significantly associated with differences in post-task PA or PA recovery and cultural values did not significantly moderate effects of condition on PA.

Sensitivity Analyses

A series of additional post-hoc analyses and modeling strategies were considered as alternatives. Regarding potential confounds for the study moderators, Latino and mainstream cultural values were not significantly associated with baseline cortisol, NA, or PA; concurrent

depressive symptoms; or general perceived stress reported prior to college, *p*s > .094. Regarding associations among outcome variables, bivariate correlations indicated cortisol samples collected immediately after the task (i.e., 2nd sample) were significantly negatively associated with NA 15-min post-task (i.e., 3rd measure), $r = -.25$, $p = .023$; all other correlations between cortisol and NA were not significant, *p*s > .177. Model results presented for cortisol (Table 2) were similar when also adjusting for concurrent state NA, and results presented for NA (Table 3) were similar when also adjusting for concurrent cortisol levels. Regarding the time specificity of intercept results (i.e., mean 15-min post-task levels), mainstream values did not significantly moderate the effect of condition on cortisol levels when time was centered at baseline, $p = .710$, or the 2nd sample immediately after the task, $p = .077$, indicating the result was specific to peak cortisol levels collected 15 min after the task, $p = .031$ (see Table 2, Model 2).

Discussion

The cultural mismatch that exists between universities and underrepresented students (Gloria and Robinson Kurpius, 1996; Stephens et al., 2012a) has acute physiological consequences (Stephens et al., 2012b; Zeiders et al., 2018) and potentially long-term health implications (McEwen, 2004; Myers, 2009). This study tested a novel approach to reduce perceived cultural mismatch by offering first-year Latino students a reminder of their university's mission to celebrate cultural diversity and prioritize inclusion. Viewing a video showcasing the university's commitment to this mission (compared to a control campus tour video) reduced cortisol reactivity to psychosocial stress and post-task negative affect, specifically for students endorsing higher (compared to lower) alignment with Latino cultural values (e.g., familism, respect). Further, this university message (compared to control) also reduced post-task cortisol levels for students endorsing higher (compared to lower) alignment with U.S.

mainstream cultural values (e.g., self-reliance, competition). These findings indicate that perceiving university efforts in support of diversity and inclusion can affect the HPA axis response to college-relevant psychosocial stress, while also revealing novel cultural variation in these stress responses along two value dimensions.

This experimental design was based on *cultural mismatch theory*, which suggests that emotional distress and socially evaluative threat can result, in part, from the lack of correspondence between students' value orientations and the college cultural context (Stephens et al., 2012a, 2019). Not unlike situations in which many Latino college students find themselves on a daily basis (Zeiders et al., 2018), mainstream cultural expectations were made explicitly clear in a modified version of the Trier Social Stress Test by asking participants to speak about why they were *uniquely* qualified to *win* an award in front of peer evaluators. Even a relatively brief reminder promoting perceptions of the university's commitment to cultural diversity and inclusion reduced cultural mismatch with this individual achievement-focused stress task, indexed by lowered cortisol reactivity and emotional distress. Consistent with hypotheses, these effects emerged for students who more strongly valued the importance of maintaining family closeness, family obligations, and deriving one's sense of self from the family unit, which are cultural values otherwise at-odds with U.S. mainstream expectations reinforced in college settings that emphasize independence, self-reliance, and competition. These students who viewed the culture-focused and inclusive message may have felt more accepted or perceived less threat to the self during the socially evaluative task, compared to those with similar values in the control group. Prior analyses focused on diurnal cortisol patterns among Latino adolescents in this larger longitudinal study demonstrated that cortisol levels were lower following everyday stress prior to college for those with higher (compared to lower) Latino heritage values (Sladek

et al., 2019), suggesting that the current study findings observed in a laboratory may correspond to physiological regulation in daily life. Relatively lower HPA and affective reactivity to college-related stressful circumstances, though acute in this study, may contribute to improved mental and physical health trajectories over time (Myers, 2009; Pascoe and Smart Richman, 2009).

Viewing the cultural diversity and inclusion reminder also reduced post-task cortisol levels (compared to control) for students with stronger orientation to U.S. mainstream cultural values, though this effect was not specific to task reactivity. These students who endorsed valuing self-reliance and competition may have been particularly sensitive to a task that rewarded these very ideals, evidenced by higher post-task cortisol levels (i.e., 30 min post-stressor onset) in control compared to culture conditions. Particularly in the higher education system where this independent, competitive spirit is deeply valued (Stephens et al., 2012a), heightened HPA responses to speaking in front of expert peers may be adaptive to prepare for the task at hand. It is possible these relatively more independent and competitive students were also more attentive to content provided in the culture-related reminder, thereby increasing efficacy to cope with the task and recover more efficiently (Sladek et al., 2016). The slight positive association between mainstream and Latino cultural values, and the differential prediction of experimental effects on stress responses by value dimensions in this study, suggests the need for further examination at the intersection of these distinct cultural dimensions. For example, consistent with the dual cultural adaptation framework (Gonzales et al., 2004) and prior research with Mexican American adolescents (e.g., Gonzales et al., 2018), the extent to which Latino students have internalized both sets of values (e.g., high heritage values *and* high mainstream values) may uniquely predict stress responses over and above either single dimension.

An important methodological feature of this study was the bilinear spline growth modeling approach, which allowed for the simultaneous consideration of different features of the stress response profile, including *reactivity*, *post-task levels*, and *recovery* (Adam et al., 2007; Nicolson, 2008). This spline modeling approach also identified individual differences in each of these features of stress response patterns across the focal outcomes, which were accounted for in different ways by different cultural value dimensions in each experimental condition. More research is needed to clarify why experimental differences in cortisol *reactivity* varied by students' endorsement of Latino cultural values, whereas differences in *post-task levels* varied by students' U.S. mainstream cultural values. In the larger study from which this sample was drawn, Latino adolescents who endorsed higher (compared to lower) mainstream values tended to have higher cortisol levels at waking and steeper (i.e., more efficient) diurnal cortisol slopes prior to college (Sladek et al., 2019), suggesting a link between internalizing the dominant values of U.S. mainstream society and stress regulation throughout the day. The lack of variation in average stress *recovery* trajectories in the current study likely reflected the nature of this experimental manipulation, which modified the video message viewed prior to the stress task but otherwise maintained consistent experiences across conditions following the task. As other studies have done with training in coping strategies (e.g., Bendezú and Wadsworth, 2018), future research may consider more direct ways to support Latino students in the recovery process following a stressor.

The current results complement prior studies showing the psychological and academic benefits of brief value affirmation exercises (Covarrubias et al., 2016; Sherman et al., 2013), as well as the few studies showing that related manipulations can reduce cortisol reactivity (Creswell et al., 2005; Tsai et al., 2016). The present study is the first among this important work

to use and test the utility of a video message with strong external validity that may be delivered on a larger scale via online platforms to incoming students during orientation sessions. If even this very brief, easily deliverable reminder helped reduce acute stress responses, this presents exciting opportunities to test more rigorous interventions as students begin college. However, the message presented in this study was produced by an institution that prides itself on an inclusive mission. Indeed, almost all participants (in both conditions) rated the university as a diverse and inclusive place that values students of all cultural backgrounds, demonstrating the relatively ubiquitous understanding of this mission in this college context. Transferring a similar manipulation to other institutions with different histories of commitment to diversity and inclusion will require attention to authenticity of the message. Further, without broader systemic changes to reduce higher education inequality, brief psychological interventions based on manipulating perceptions of university goals may be inconsistent with underrepresented students' lived experiences, and thus rendered ineffective.

Regarding study limitations, this sample of Latino adolescents attended one large, public 4-year university in the southwestern U.S. Although the larger study drew participants from over 90 different high schools in this region (Doane et al., 2018b), future research should consider other university contexts that vary in size, location, and progress on diversity and inclusion. Findings should be replicated with larger samples to explore generalizability. Sample size limitations prevented group comparisons among Latinos (e.g., Mexican, Cuban, etc.), but future work should continue to account for these and other culture-related differences.

Due to the universal nature of the diversity and inclusion message, which was not designed for delivery to a specific group of students, future research should also consider applying this model to university students of other ethnic-racial groups and testing how long-

lasting the benefits may be. Though this study focused on the first-semester college transition experiences of Latino students, university efforts to promote cultural diversity and inclusion likely benefit other underrepresented student groups (e.g., first-generation college students of different ethnic-racial groups, other students of color, immigrant students), and may also benefit ethnic-racial majority (i.e., White) students (e.g., Stephens et al., 2012b). Future research is needed to better understand the effects of this type of university messaging with diverse groups, as well as to identify the duration of any long-term impacts through the college years. Consistent with the minority status stress model (Smedley et al., 1993), stress responses during the first college semester may serve as a mediator that helps to explain how college transition stress influences later health and success. As in the current study, this future research should account for the diversity that exists *within* groups and measure cultural assets of minoritized students that may differentiate their experiences as they navigate mainstream cultural expectations in the college context. Finally, future research is needed to explore the specificity of these results to neuroendocrine function, including studies designed to test the role of cultural (mis)match in other biological systems involved in psychosocial stress responses (e.g., immune, sympathetic).

Conclusions

Results from this study support the perceived value of diversity and inclusion efforts at institutions of higher education. Offering a brief reminder of institutional commitment to cultural diversity and inclusion reduced neuroendocrine and affective responses for first-year Latino students, and these effects varied by students' cultural value orientations. Despite the simplicity of this psychological intervention, the findings suggest the potential for broad impact to reduce perceived cultural mismatch and resulting distress when colleges and universities respect and celebrate cultural differences among their students during the college transition.

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Table 1

Descriptive Statistics by Experimental Condition

	Culture Condition (n = 45)		Control Condition (n = 39)	
Dependent Variables	*M* (*SD*)	Range	*M* (*SD*)	Range
Baseline cortisol	4.44 (2.35)	1.55 – 13.15	3.79 (2.42)	1.20 – 11.39
Post-task cortisol (+30 min)	5.28 (2.90)	1.63 – 13.00	5.54 (4.72)	1.27 – 28.98
15-min post-task cortisol (+45 min)	6.41 (3.82)	1.13 – 16.22	7.26 (5.69)	1.17 – 32.32
30-min post-task cortisol (+60 min)	4.81 (2.62)	1.28 – 13.61	5.19 (3.42)	1.13 – 15.02
45-min post-task cortisol (+75 min)	3.70 (1.75)	1.07 – 10.02	4.29 (2.42)	0.88 – 10.14
Baseline NA	0.26 (0.24)	0.00 – 1.00	0.43 (0.64)	0.00 – 3.00
Post-task NA (+30 min)	0.80 (0.63)	0.00 – 2.60	0.83 (0.79)	0.00 – 3.70
15-min post-task NA (+45 min)	0.24 (0.31)	0.00 – 1.80	0.36 (0.58)	0.00 – 2.80
30-min post-task NA (+60 min)	0.17 (0.23)	0.00 – 0.90	0.27 (0.70)	0.00 – 3.70
45-min post-task NA (+75 min)	0.17 (0.22)	0.00 – 0.80	0.20 (0.58)	0.00 – 3.20
Baseline PA	1.31 (0.71)	0.30 - 2.90	1.40 (0.79)	0.00 - 3.00
Post-task PA (+30 min)	1.09 (0.84)	0.00 - 3.50	1.15 (0.79)	0.00 - 2.90
15-min post-task PA (+45 min)	0.96 (0.76)	0.00 - 3.00	1.21 (0.92)	0.00 - 3.20
30-min post-task PA (+60 min)	0.78 (0.68)	0.00 - 2.90	0.96 (0.81)	0.00 - 3.00
45-min post-task PA (+75 min)	0.79 (0.63)	0.00 - 2.60	1.02 (0.91)	0.00 - 3.20
Moderators	*M* (*SD*)	Range	*M* (*SD*)	Range
Latino cultural values	3.29 (0.62)	1.92 – 5.00	3.24 (0.87)	1.06 – 4.69
U.S. mainstream cultural values	3.03 (0.72)	1.50 – 4.86	2.85 (0.78)	1.29 – 4.71
Covariates	*M* (*SD*)	Range	*M* (*SD*)	Range
Time since waking (hours)	6.76 (2.25)	1.70 – 10.55	7.44 (1.85)	3.42 – 13.03
Immigrant generation	2.62 (2.28)	0.00 – 7.00	2.49 (2.26)	0.00 – 7.00
Depressive symptoms	16.33 (8.82)	0.00 – 39.00	18.05 (9.03)	3.00 – 51.00
Male[a]	40.0%	--	33.3%	--
Oral contraceptive use[a]	2.2%	--	12.8%	--
Living at home[a]	22.2%	--	28.2%	--

Note. N = 84. Averages of cortisol levels (nmol/L), negative affect (NA), and positive affect (PA) presented for descriptive purposes; natural log transformation used for cortisol and square root transformation used for NA in analyses. Immigrant generation: 0 = participant, parents, and both sets of grandparents born outside U.S. to 7 = all born in U.S. Male: 1 = male, 0 = female. Oral contraceptive use: 1 = yes, 0 = no. Living at home: 1 = living at home, 0 = living in university housing.
No significant differences by condition, all pairwise *p*s > .092.
Cortisol values from one participant and affect scores from two participants were statistical outliers (> 3 *SD*s above time-specific means). Model results were consistent with or without excluding these data, and thus were retained in final analyses.
[a] Percentage of condition.

Table 2

Experimental Condition x Cultural Values Interaction Predicting Cortisol Responses

Moderator: **Latino Cultural Values**	Model 1	
	Est.	95% CI
Intercept (15-min post-task cortisol level), b_0	1.634*	[1.432, 1.836]
Condition (1 = culture), β_{01}	-0.128	[-0.361, 0.105]
Latino cultural values, β_{02}	0.254*	[0.068, 0.440]
Condition x Latino cultural values, β_{03}	-0.263	[-0.590, 0.064]
Male, β_{04}	0.266*	[0.039, 0.493]
Time since waking, β_{05}	-0.040†	[-0.083, 0.003]
Oral contraceptive use, β_{06}	-0.412*	[-0.822, -0.002]
Living at home, β_{07}	0.192	[-0.041, 0.425]
Reactivity (time until 3rd sample), b_1	0.010*	[0.006, 0.014]
Condition (1 = culture), β_{11}	-0.005†	[-0.011, 0.001]
Latino cultural values, β_{12}	0.006*	[0.0001, 0.012]
Condition x Latino cultural values, β_{13}	-0.010*	[-0.020, -0.0002]
Male, β_{14}	0.005†	[-0.001, 0.011]
Recovery (time since 3rd sample), b_2	-0.015*	[-0.017, -0.013]
Moderator: **U.S. Mainstream Cultural Values**	Model 2	
	Est.	95% CI
Intercept (15-min post-task cortisol level), b_0	1.653*	[1.479, 1.827]
Condition (1 = culture), β_{01}	-0.154	[-0.374, 0.066]
Mainstream cultural values, β_{02}	0.359*	[0.175, 0.543]
Condition x Mainstream cultural values, β_{03}	-0.337*	[-0.645, -0.029]
Male, β_{04}	0.274*	[0.023, 0.498]
Time since waking, β_{05}	-0.035	[-0.078, 0.008]
Oral contraceptive use, β_{06}	-0.392†	[-0.821, 0.037]
Living at home, β_{07}	0.205	[-0.040, 0.450]
Reactivity (time until 3rd sample), b_1	0.011*	[0.007, 0.015]
Condition (1 = culture), β_{11}	-0.006*	[-0.012, -0.0001]
Mainstream cultural values, β_{12}	0.008*	[0.002, 0.014]
Condition x Mainstream cultural values, β_{13}	-0.006†	[-0.014, 0.002]
Male, β_{14}	0.005†	[-0.001, 0.011]
Recovery (time since 3rd sample), b_2	-0.015*	[-0.017, -0.013]

Note. N = 420 samples nested within 84 individuals. Cortisol values (nmol/L) transformed using the natural log function. Time scaled in minutes. Continuous level 2 predictors grandmean centered. Est. = regression coefficient estimate (unstandardized). CI = confidence interval.
†$p < .10$. *$p < .05$.

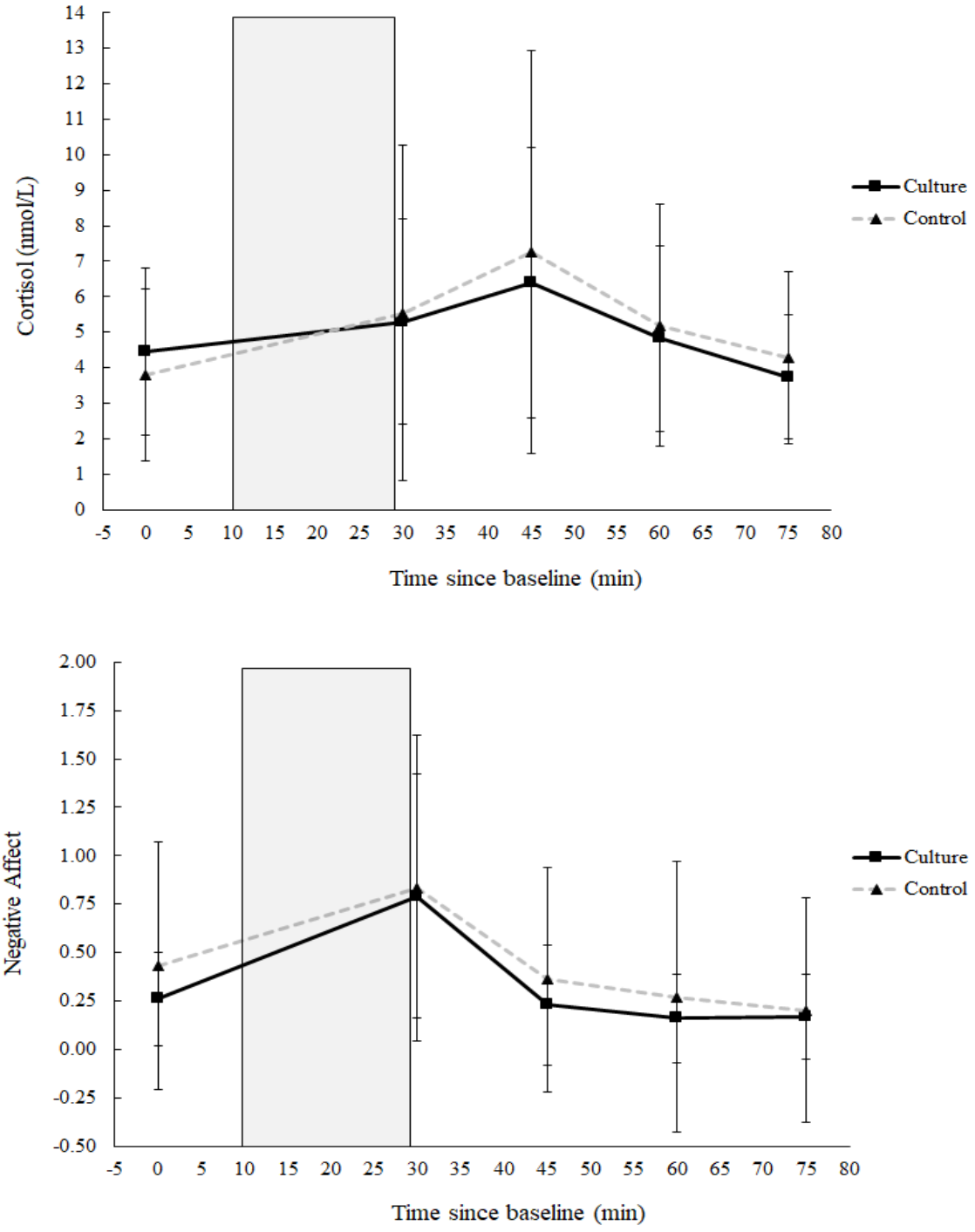
Table 3

Experimental Condition x Cultural Values Interaction Predicting Negative Affect Responses

Moderator: **Latino Cultural Values**	Model 1	
	Est.	95% CI
Intercept (post-task NA), b_0	0.832*	[0.712, 0.952]
Condition (1 = culture), β_{01}	-0.037	[-0.155, 0.081]
Latino cultural values, β_{02}	0.042	[-0.097, 0.181]
Condition x Latino cultural values, β_{03}	-0.181*	[-0.346, -0.016]
Male, β_{04}	-0.022	[-0.142, 0.098]
Immigrant generation, β_{05}	-0.020	[-0.047, 0.007]
Depressive symptoms, β_{06}	0.016*	[0.010, 0.022]
Reactivity (time until 2nd measure), b_1	0.012*	[0.010, 0.014]
Recovery (time since 2nd measure), b_2	-0.033*	[-0.039, -0.027]
Condition (1 = culture), β_{21}	0.002	[-0.001, 0.004]
Latino cultural values, β_{22}	-0.001	[-0.003, 0.001]
Condition x Latino cultural values, β_{23}	0.002	[-0.003, 0.005]
Male, β_{24}	0.004*	[0.002, 0.006]
Immigrant generation, β_{25}	0.0001	[-0.001, 0.001]
Depressive symptoms, β_{26}	0.0001	[-0.0001, 0.0003]
Recovery squared (time since 2nd measure^2), b_3	0.0004*	[0.0002, 0.001]
Moderator: **U.S. Mainstream Cultural Values**	Model 2	
	Est.	95% CI
Intercept (post-task NA), b_0	0.825*	[0.703, 0.947]
Condition (1 = culture), β_{01}	-0.033	[-0.151, 0.085]
Mainstream cultural values, β_{02}	-0.001	[-0.173, 0.171]
Condition x Mainstream cultural values, β_{03}	-0.078	[-0.264, 0.108]
Male, β_{04}	0.010	[-0.117, 0.137]
Immigrant generation, β_{05}	-0.015	[-0.042, 0.012]
Depressive symptoms, β_{06}	0.017*	[0.009, 0.025]
Reactivity (time until 2nd measure), b_1	0.012*	[0.010, 0.014]
Recovery (time since 2nd measure), b_2	-0.033*	[-0.039, -0.027]
Condition (1 = culture), β_{21}	0.002	[-0.001, 0.004]
Mainstream cultural values, β_{22}	0.0004	[-0.004, 0.004]
Condition x Mainstream cultural values, β_{23}	0.001	[-0.003, 0.005]
Male, β_{24}	0.004*	[0.002, 0.006]
Immigrant generation, β_{25}	0.0001	[-0.001, 0.001]
Depressive symptoms, β_{26}	0.0001	[-0.0001, 0.0003]
Recovery squared (time since 2nd measure^2), b_3	0.0004*	[0.0002, 0.001]

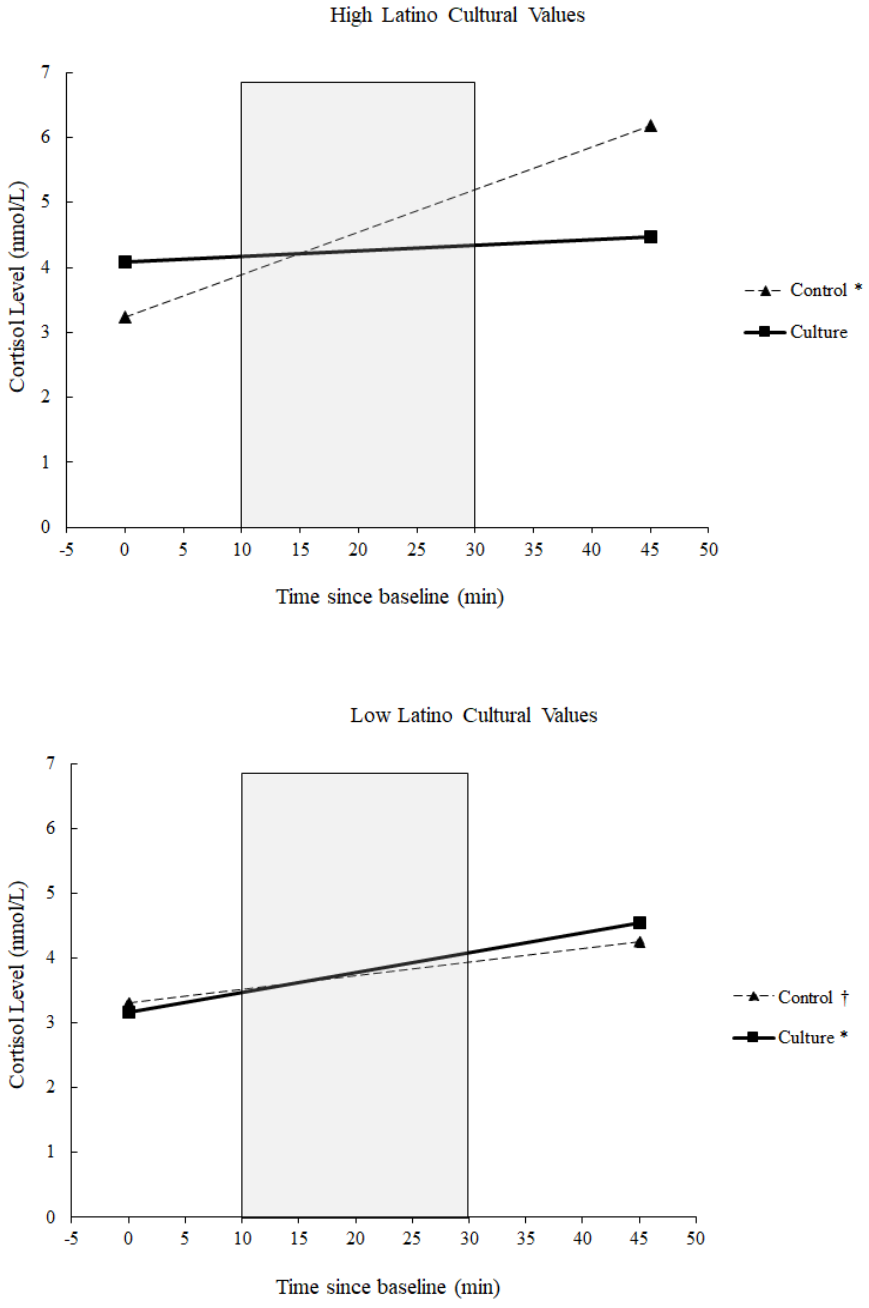
Note. N = 420 measures nested within 84 individuals. Negative affect (NA) transformed using square root. Time scaled in minutes. Continuous level 2 predictors grandmean centered. Est. = regression coefficient estimate (unstandardized). CI = confidence interval. †$p < .10$. *$p < .05$.

Figure 1



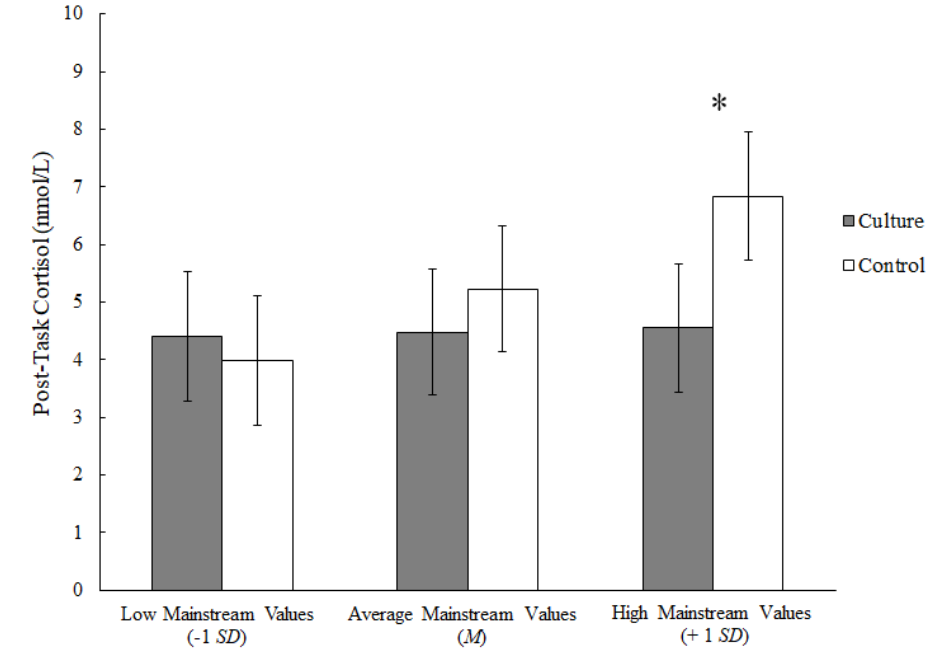
Note. Mean plots of psychosocial stress response patterns. Shaded region indicates duration of psychosocial stress task. (control = pre-task campus tour video; culture = pre-task cultural diversity/inclusion video). Error bars reflect +/-1 *SD*. On average, no significant mean differences between culture (n = 45) and control (n = 39) conditions, pairwise ps > .11. Significant increases in cortisol and NA as a function of the stress task, followed by significant decreases, ps < .05 (see Tables 2 and 3).

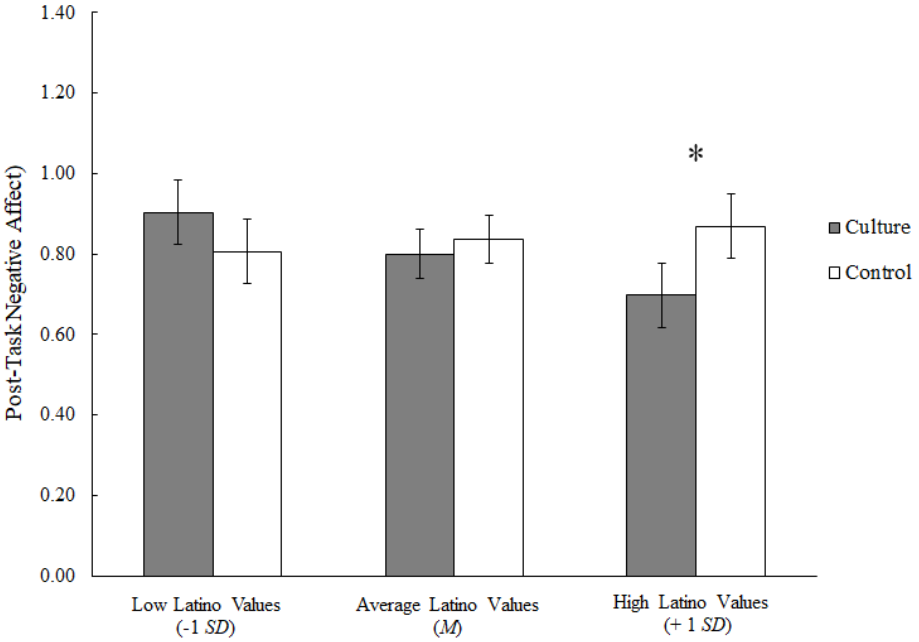
Figure 2



Note. Simple slopes of cortisol reactivity (rate of increase from baseline to 15-min post-task) by experimental condition (control = pre-task campus tour video; culture = pre-task cultural diversity/inclusion video) for participants with high Latino cultural values (+1 *SD*) and low (-1 *SD*). Shaded region indicates duration of psychosocial stress task.
*Slope significantly different from zero, $p < .05$. †$p = .052$.

Figure 3





Note. Simple intercepts by experimental condition (control = pre-task campus tour video; culture = pre-task cultural diversity/inclusion video) plotted at the mean and +/-1 *SD* of cultural values. Error bars represent +/-1 *SE* of intercept estimate.
*Significant difference by condition, $p < .05$.